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THE BURIAL GROUNDS OF THE MING DYNASTY.

THE history of China is marked by the alternate rule of native and foreign dynasties. The house of Tsing, to which the present rulers belong, is of Tartar race, and revolutions with the object to free the nation from foreign domination have occurred from time to time, and may break out again, as there are powerful secret societies in China working for the overthrow of the ruling dynasty. As the scepter is now in the hands of the Mantchoo-Tartars, so it was held up to the fourteenth century by Mongolian monarchs. At that time the crown was wrested from the invaders by Tsen-Yueng-Tsang, the founder of the Ming dynasty, who, from a simple bonze or priest, rose to be first a brigand chief, then the leader of a national insurrection, and finally emperor.

The Mings reigned from 1368 to 1644, when they succumbed to the Tartar invasion. Fourteen emperors of this dynasty ruled China, and they are all buried at the same place near Chang-ping-cho, with the exception of King-tai-hoang-ti, who reigned for Ying-tsung, the fourth emperor of the dynasty, while he was held captive by the Tartars.

The graves are in a plain, so that the entire grounds can be readily overlooked from a near-by hill, and the present emperors, although of a different dynasty, take good care of the monuments, which are always guarded by soldiers, and periodically inspected by officials sent by the Minister of Public Works. Formerly the Mantchoo-Tartar emperors even went so far as to offer sacrifices at the graves of their predecessors; but this practice has been discontinued long ago, and the rites are now performed twice a year by a descendant of the Mings. The emperors are buried with their wives and favorite concubines, and originally there prevailed the barbarous custom of burying these women alive with their dead sovereigns. Ying-tsung decreed that the women should be buried in the mausoleums only after their death.

The burial grounds are remarkable not only by the tombs themselves, but by a monumental gate, having five passages or arches, of which the central passage is the largest, the others being progressively smaller. At some distance from this entrance are three gates, called Tahung-men, upon which is carved an imperial edict ordering travelers to alight from their horses. These gates are connected with the entrance by the so-called Holy Road, which in olden times was open to the emperors only; and for the burial of empresses and concubines, they made use of underground passages leading to the tombs; these passages still exist at the present day. The Holy Road is the most interesting feature of the burial grounds. It is lined on both sides with colossal monolithic statues, standing about 200 yards apart. There are in all thirty-six statues, of which twenty-four represent animals and twelve high dignitaries or celebrities. The statues are exceedingly well made and by no means crude productions; their artistic execution is no less a source of wonder than the presence of these monuments at a point which evidently is far away from the quarries whence the monoliths were taken. The statues are made without pedestals, and are disposed in groups of four each. First come four lions, then four rams, then camels, elephants, horses, and finally chimeras. In each group two animals are represented standing and the other two lying down. The illustrations give a good idea of the gigantic size and of the surprising artistic merit of the statues. After the animals follow the statues of four military mandarins, four civilian mandarins, and four of China's celebrated men.


A MILITARY MANDARIN.

Thirteen hills surround the burying grounds, and from each of them a good general view may be obtained. The impression created by this strange sight is quite peculiar. The statues of the animals, rising immediately from the ground without pedestals, and surrounded by the high grass, have a degree of realism which is entirely lacking in Occidental statuary, with its elaborate pedestals and inclosures. It is to be hoped that these remarkable works of unknown artists will pass unharmed through the violent upheaval which now threatens to disrupt the Chinese Empire. For our illustrations we are indebted to L'Illustrazione Italiana.


STANDING ELEPHANT.


ELEPHANT LYING DOWN.


THE CAMELS.


HORSE.

COLOSSAL STATUES AT THE BURIAL PLACE OF THE MING DYNASTY.

TRIPOLI DATES.

THE number of date palms in the vilayet of Tripoli, North Africa, is computed at 2,000,000, and the date palm is the most important of all trees, all its component parts serving usefully in some way or another; the fruit for food, the leaves for mats and hut coverings, the wood for building and fuel, the fiber for baskets and ropes, the juice for drinking, and, finally, the stones made into a paste are given as food to animals. A certain quantity of date stones is exported to Italy to adulterate coffee. Consul-General Jago says that date paste also forms an article of export to Egypt and Turkey. The date enters largely into the food of the people, especially during poor cereal harvests, when its price is governed by that of barley. The tribes of the Fezzan consume large quantities of the Tripoli dates as their principal food, and every autumn caravans arrive from the interior, especially at Misurata, for the purposes of purchase. Animals are fed on them in the oases of the interior. A large consumption of logbi, or palm wine, the juice of the tree, takes place in the country among all

classes, religious prejudices not applying to it as an intoxicant; the season is from May to October. An incision is made near the top of the tree, and the sap allowed to flow into an earthenware jar, which is attached and changed twice a day. The flow continues nearly three months, but not always in the same quantity. A good tree produces logbi to the value of two shillings to two shillings and sixpence per day, but its extraction causes it to produce no fruit for the next two or three years. The consumption, however, is great, and little labor is required. The total annual value is about £3,200, the tax being twenty shillings per tree excised. When taken fresh from the tree it resembles milk, and has a sweet taste, but later on becomes sour. A small quantity of spirit, called "bokha," is distilled from the date, and is consumed locally. It is an intoxicant, and somewhat resembles arrack. Efforts to export dates to Europe for distilling purposes have failed, owing to heavy import duties. The export of dates to Bengazi, Egypt, and Turkey varies between £700 and £2,000, according to good or bad seasons, and chiefly from Zleiten, Misurata, and Tuarga. Plantations are rare, except in those parts which are exempt from taxation.—Journal of the Society of Arts.

[Continued from SUPPLEMENT, No. 1281, page 20538.]

RUSSIAN CENTRAL ASIA: COUNTRIES AND PEOPLES.

By ARCHIBALD R. COLQUHOUN.

A RUSSIAN colony, with the Governor-General in his palace as the center, and the usual military and civil officials and their families, has now its own quarter, side by side with the quaint Oriental town of Tashkent. The little houses of Russian merchants and officials are whitewashed, trim and neat; the Governor's palace has an ornamental garden around it, laid out in artificial lakes and little hills and dales, where a military band plays every evening. There are stiff public buildings, a wide square, an ugly little church, and a new improved bazaar has been erected at great cost, which has, however, entirely failed in its object of drawing the trade of the town from the native quarter, and so subjecting it more completely to Government influence. The natives did not take kindly to this arrangement, and the trade of Tashkent is still carried on in the old bazaar, which has probably existed in much the same form for hundreds of years.

The bazaar is a most important feature of life in all Oriental countries, and as all bazaars in Central Asia have a family likeness that of Tashkent will serve as a very fair type. No changes or improvements have been effected in it since the Russian occupation. The street, as the gate is neared, grows narrower, and little shops cluster on either side; in the bazaar itself it is exceedingly narrow, rough and ill-paved. A very favorite method of paving in Central Asia is by laying large blocks of stone, between which are channels of mud in winter, and in summer of thick, white dust. Over these the Khirgiz bumps along on his camel, quite unconcerned, and if the pedestrian does not keep carefully to the raised sidewalk of mud he may be knocked over or jostled by these camels. The shops are small wooden huts of one or, at most, two rooms, the front of which is taken down bodily to show the interior. In the center, on a mat, the seller sits cross-legged, or, perhaps, it is a manufacturer with his tools in hand. Round him are displayed his wares, and there is little room for his customers, who must stand outside to do their bargaining. There is none of the hurry and bustle of European shopping; the merchant displays no undue eagerness to sell his goods, and the buyer is equally self-possessed and leisurely. Theoretically, there are thirty-two different trade guilds which must be represented in the bazaar; practically, there are more. Each guild is supposed to have thirty-two branches, and each must have a different shop; thus, in brass-working (sometimes very beautifully done), one will make the bowl or ewer, another the bottom, another the lid, a fourth will solder them together, while at a fifth, with a sharp chisel, the decoration is worked out. Almost every trade has its own street, the shops on either side being devoted to shoe, or harness, or crockery making in all their different branches.

The Kirghiz have a special quarter of their own in the great bazaar Tashkent, and here is sold the really beautiful felt made by the women, also coarse carpets and other articles of nomad manufacture. Here and there are arched gateways, behind which are caravanserais, some used by local merchants for storing their goods, and others as hostelries for foreigners. Here the merchandise lies about in piles, the camels and horses stabled around the sides of the court, while overhead the merchants "live, move, and have their being," in an atmosphere which is, luckily, peculiar to bazaars.

Every Mussulman city, to be en règle, must have a "jumma," or mosque, large enough to hold all the inhabitants on Fridays. Looking from the platform of the mosque in Tashkent (whence the mullah calls to prayers,) one sees apparently nothing but a flat clay plain, beyond which rises a hill with another mosque, and the domed roof of a bath. This plain is composed of the mud roofs of the bazaar, for the streets are so narrow that one can only see them from below, and as the roofs are often overgrown with grass and poppies, this adds to the illusion. The barber's shop is also the chemist's, and here soap—very unpleasant in smell—is sold, and also the cosmetics, which a good Mussulman lady is enjoined to use in order to preserve her beauty, and so please her husband.

The natives of Tashkent are mostly Uzbeks, with a few Tadjiks, Tartars, Kirghiz, Hindoos, and others who come to trade. The population is difficult to gage, but it is probably over 120,000.

The Hindoos are the great money lenders of Central Asia, and have their own caravanserais in most towns, but under Russian rule, unlike that of the English in India, land does not pass by sale or mortgage into their hands. The Jews are also numerous, and have enjoyed greater freedom (little though that be now) since the advent of the Russians. Formerly in many towns they were confined to a certain quarter and treated with much contempt, having very few civil or municipal rights, and being compelled to wear a girdle of common rope as a badge of their nationality.

Cotton and silk goods, of course, occupy a large portion of the bazaar, and in the booths one can see the men at work with their rough machines of wood, dexterously manipulating reels and turning spindles. The embroidery of robes is also done by men, and is in very great demand, the robe or material being stretched over a wooden hoop, the pattern roughly chalked, and the work executed with a kind of crochet-needle, with which the silken thread is pulled into a chain stitch. There is no liquid measure in Central Asia, everything being reckoned by weight, and the standard varies in almost every town. The coins also, the most common of which is known as the tenga, have different values in different parts. The Russians have tried to regulate this, and are introducing their own money, which now passes current all over Central Asia.

The native houses of the better class in Tashkent, as in other Central Asian cities, have three, or at least two, courts. The first, if there are three, is used as a stable for the animals, which are accommodated in sheds round the sides. The second is the man's court, on two sides of which are the balconies of the house; while a third, frequently, has a sort of platform, used as a terrace, where the master and his friends sit to get the full benefit of the air. The house generally contains one large room, opening on the portico—the guest-chamber, with one or two smaller ones opening into it. The doors are often beautifully carved, and instead of hinges they hang on a sort of pivot let into the lintel and threshold. Windows, as a rule, there are none, but a small open space above the doors, with lattice-work let in, either open or covered with white paper, glass being still uncommon in the typical native house. The ceilings are very curious and sometimes strikingly pretty, being composed of small round willow boughs set in between the rafters, and picked out in colors, with an occasional touch of gold. The walls are plastered and frequently painted with pictures of fruits, flowers, or small arabesques, and there are numerous niches with arched tops which act as shelves, on which are stored books, clothes, crockery, or food. There is usually very little furniture, unless the merchant has become bitten with the craze to imitate the Russians, in which case there are cheap tables and chairs of a conventional type imported from Russia, for such things are not made in Tashkent. The truly native house, however, contains little but rugs and mattresses, with perhaps a small round table, or a carved or painted wooden cupboard. The women's quarters are very much the same in arrangement and furniture, except that they may have a broad bed—the charpoy of India—made of a wooden frame with a network of ropes, raised a few feet from the floor. The usual bed is merely a rug or a thin mattress stretched on the ground. In many of the rooms a small basin is let into a corner of the floor, with a jug standing by, for the numerous ablutions required by the Mussulman's religion.

The merchant who lives in this house is attired in a pair of loose white trousers made of cotton, and tied round his waist with a cord and tassels. His shirt, also of light-colored cotton, is very long, with a small slit for the neck, and wide sleeves; over this he wears a tchapan, or two or three, according to the weather. This garment is a long coat, cut very sloping at the neck, and with enormous sleeves, much too long for convenience, but satisfying the Asiatic sense of propriety, which requires that the hands be covered. The tchapan is of cotton or silk in summer, often striped or patterned in the most gorgeous colors; in winter one gown will be made of cloth and lined with fine sheepskin or fur. A scarf or small shawl is twisted round the waist, and a turban, either of striped cotton or, if the wearer is a mullah or distinguished for piety, of white material is wound round the head over a little embroidered skull cap.

The dress of the women is very similar, but their gowns are more often of silk, and many strings of beads, gold, and gems are worn round the neck, with bracelets, anklets, hair ornaments, and sometimes nose-rings. Outside they wear a thick veil of woven horsehair and a dark blue or green cloak with long sleeves. The class of women who go abroad unveiled is such that even Jewesses and others, whose religion does not demand it, cannot venture out without these hideous garments. This applies, however, only to the purely Mussulman cities. In the east, where the Buddhist element is strong, an unveiled woman is occasionally seen, while the custom has never obtained among the Kirghiz and other nomad tribes, whose Mohammedanism is even less than skin deep.

Although there are hotels in Tashkent, and in many other Central Asian towns, they are by no means according to Western ideas of comfort, resembling in arrangement the caravanserai already described. The food of the country is mutton, mutton, mutton! In the town there is some attempt to vary the method of cooking; but, as a rule, the dishes are too greasy and insipid for European palates. Wine can be got in Tashkent, imported from Russia, at fabulous prices, but the native drink is green tea, black tea having been only introduced by the Russians, and this is sometimes thickened with cream or melted tallow, and sometimes flavored with a small dried lemon.

The walls of Tashkent are said to have been sixteen miles round, but were largely demolished by the Russians to make barracks and parade-grounds. Outside these walls and the gardens surrounding them is the open steppe, over which are dotted numerous villages, mostly inhabited by either Tartars or Kirghiz, the races who mingle in the city keeping apart here. One is a sort of summer residence for the Governor and his little court, and at another is a large establishment for the breeding and improvement of horses, nominally a private enterprise, but in reality subsidized by the Government, which realizes the importance of a plentiful supply of horses from a strategical point of view.

Altogether, Tashkent is a curious and typical example of East meeting West. The modern Russian soldier and his Paris-dressed wife rub shoulders with the Usbek or Kirghiz, whose ancestors were Khans and Beks in this country at a time when Russia was a mere congeries of half-savage States; or with the Mongols, whose warrior kings in the days of old not only conquered Russia, but a great portion of the then known world; or with the Tadjiks, of almost prehistoric origin, former owners of the soil, who were dispossessed by Kirghiz and Mongol alike, but still retain their individuality. All these varying peoples have accepted the yoke of their Western conquerors. The Oriental is, above all, a fatalist, and he recognizes the inevitable wave of Russian advance.

The Mohammedan religion, almost universal in Central Asia, gives little encouragement to those who seek pleasure and recreation, save in the exercise of religious duties and such mild excitement as learning to recite the Koran by heart. Human nature is, however, the same in the East as in the West, and the Bokharan, Khokandian, or Tashkentian, when he desires relaxation, turns to music and dancing, and even, if he is able, to horse racing. As regards the first, the Russians of course, in such cities as Orenburg, have introduced military bands and American organs; but the purely native instruments are drums, variations of the zither and guitar, whose very names betray their relationship to the instruments familiar to us; trumpets, with perhaps one deep note, and some elementary wood instruments. The music is quite unlike our own, the intervals between the notes being less, and the notation consequently extremely varied. The effect is weird and unmelodious to the unaccustomed ear; but it is certainly more in keeping with the character and appearance of the natives than a Russian military band playing the latest opera selections. Most of the instruments, and probably much of the music, were brought from Persia, and the latter has retained its pristine rudeness of construction with a conservatism peculiar to these parts. Another instrument which is a great favorite, and found so generally all over the world that we are forced to believe it embodies some unspoken sentiment common to all mankind, is the Jew's-harp, which bears here the very appropriate name of tchang. The nomad tribes, and particularly the Kirghiz, have mournful, monotonous songs of great length, some not at all unpleasing to the ear, which differ a good deal in style from the music of the towns, and probably owe their inspiration to the Mongol, and not the Persian element.

The tambourine in different forms is much used, and is the favorite accompaniment to dancing. The latter is not really permitted to the true believer, nor are women allowed to appear in public and dance; but that does not interfere with the desire for a recreation which appeals to the sense of beauty and love of grace inherent in the most primitive race. Youths and boys are therefore trained to take the place of dancing girls, and are a recognized institution all over Central Asia, although most in vogue in Bokhara and Samarkand.

Besides dancers, there are comedians, such as are seen in Indian and other Eastern countries. These, with whitened faces (which remind one oddly of the pantomine clown so well known to Western playgoers), and a bit of rag or a few cloths to simulate various garbs, will act small comedies, often very obscene and vulgar, but undeniably clever; representations of familiar street scenes, buyer and seller, kazi and suitor, teacher and scholar, or will mimic animals in an extremely life-like manner.

The festivals of saints, some of whom were merely successful warriors, with no particular claim to sanctity, are great opportunities for recreation, which usually takes the form of a pilgrimage to the tomb, and a kind of fair and picnic combined. Booths are erected, and the ground is covered with tents and little inclosures, in which music and dancing are largely patronized.

There are certain epochs in the life of a Mussulman in Central Asia which are also marked by feasting and merry-making.

Among the Sarts, the dwellers in towns (practically the merchant and artisan classes of Central Asia), a boy is considered marriageable from the age of fifteen or sixteen, and a girl between eleven and fifteen, or even earlier, although this is becoming rare. The courtship, as in all Mussulman countries, is carried on through a third person, who arranges the amount of kalim, or purchase money, which is not always paid to the parents, as among more primitive tribes, but is a kind of marriage settlement. Before the marriage feasts are given by the bride to her friends, and by the bridegroom to his, and on the wedding day a grand feast to all friends and relations is given in the bride's house. The marriage ceremony is performed by a mullah, or priest, but neither of the contracting parties are present, being represented by male relatives. The wedding presents are usually given by nines, that being the sacred number; and the guests not only bring, but receive, gifts. When the ceremony is over, the bridegroom can go to the women's court and claim his bride. Probably she will be concealed amidst a group of women, and he must find her hand before he can lead her out—no easy task, as he has most likely never seen her before!

The position of women in Mussulman countries can never be enviable, but in Central Asian towns she has certain rights, and if her husband does not provide for her in the way his means allow, or that by rank she is entitled to, she can complain to the kazi, or judge, a native functionary who in many places has been allowed by the Russian conquerors to continue in his former position. The kazi, if he think fit, can empower her to borrow money on her husband's account, or even sell his property to obtain what she wants. Divorce is, however, easy for the husband, who need give no reason, but must, if he parts with her, return to his wife all her belongings. She can also obtain a divorce if she can show good reason; and there is no obstacle to her remarriage unless her husband curses her, as he may if she has been guilty of any heinous crime.

The nomads naturally cannot afford the feasts which are the great indulgence and dissipation of the Sarts. Still, they have their own idea of amusements, and foremost among these are horse racing and a game played on horseback called kok-bura, or "gray wolf." The latter reminds one of polo, if one can imagine polo played on a vast steppe, with sometimes as many as a hundred players. One man has a dead kid slung over his saddle-bow, and the object of the others is to bear away this kid and carry it safely to the judge. The skill of the Kirghiz in managing their horses, and the keen zest with which they enter into the game, make it very exciting and interesting to watch. As for horse racing, it is a passion with all the nomads; and camel racing is also popular, the ungainly beasts being sometimes driven by women and girls. The number of entries for a single horse race got up at Orenburg not many years since was over a thousand.

Rather a difficult post must be that of a starter on a Central Asian race course!

The Russian Government does everything in its power to foster the breeding of horses—a very important matter in such a vast territory, where the maintenance of order is largely dependent upon irregular mounted troops. There are large studs for cavalry and artillery remounts in the Orenburg district and Turkestan; but, indeed, wherever a Cossack is found, there will be horses. These hardy soldiers, themselves only second cousins to the Kirghiz whom they have subdued, are, like the nomads, born horsemen; but, unlike them, they take an interest in the improvement of their breed of horses.

Traveling in Central Asia is usually accomplished either on horseback or in a cart resembling the Russian taratass, and is neither comfortable nor speedy unless good animals have been procured. The Russian post roads in Central Asia are not level chaussées, but merely show the direction of the track, which is marked out by post relays and a few settlements and towns. The posting stations are generally kept by a rich Cossack, who manages this in addition to farming and keeping an inn. He has to provide by contract a certain number of post horses and telegas. The postal communications are under the control of a smoitritel, usually an old soldier, who examines all the passports, and has also to see to the replenishing of the inevitable samovar, getting a few copecks for his trouble. The station has a bare whitewashed room for the convenience of travelers, containing little furniture but a table, some wooden stools, and the tea apparatus. Sometimes the posting station is a Kirghiz tent, and in past days not infrequently consisted of nothing but a water cask and a post besmeared with Russian colors. The telega, or posting car, is a small open wooden cart, scarcely five feet in length, resting on four small wooden wheels and running on two wooden axles. In the steppes the wheels frequently have neither metal rims nor boxes, so that the axles catch fire in spite of being perpetually greased. A feather and a jar of grease are an essential part of a traveler's equipment, and he must personally and at short intervals superintend the greasing if he wishes to avoid a breakdown and the serious consequences. On the front box of the telega the coachman, or jemschtchik, is perched, and the traveler must make a seat of a bundle of straw or his bag lashed to the cart. To this he must stick as closely as he can, while the Cossack horses gallop madly with the telega, which is innocent of springs, across the trackless steppe, over streams and hills and trunks of trees. The traveler, after a few days of this sort of journey, is almost deprived of feeling, indeed of any sensation, and those unaccustomed to it require some time to recover; yet the couriers, who carry important dispatches, travel so night and day for several days, only waiting at each posting station for tea, while fresh horses are brought. Innumerable glasses of tea, a few biscuits and eggs, frequently form their diet on the journey, and sometimes not even this. The difficulty of transporting troops and arms in such a country and for such distances may readily be imagined, and it is marvelous to think that Tamerlane traversed these deserts with a million men. Modern armies, with their elaborate organization—especially intricate commissariat and ambulance—can never accomplish what has been done in the past on many occasions by hordes of nomad horsemen; subsisting like the hardy animals that carried them on what they could pick up on the almost barren steppe—roots, dried meat, or a bird shot and hastily cooked.

A most characteristic feature of life in all parts of Central Asia is the custom of present giving, which has attained proportions undreamt of in Western lands, though even there it is still an important factor in social life. Presents in Central Asia are by no means voluntary or spontaneous, being given and received as a matter of course, and it is not customary to return thanks for gifts until one is congratulated on receiving them, when thanks must be returned—not for the gift, but for the congratulations. They would become a serious tax were it not that whoever receives a present must promptly give one in return. Among the Kirghiz (who carry the custom to great lengths, despite the fact that their only wealth consists practically of the tent they live in and their flocks), etiquette demands, for instance, that at a funeral feast every mourner that attends must receive a present; but then he must always bring one with him, and the two must be of equal value, so that the proprieties are satisfied, and no one is either loser or gainer in this game of forfeits. Amusing stories are told of gifts sent to each other by the rulers of the various Khanates, in pre-Russian days, which eventually found their way back to the original sender. This system in Central Asia is a great nuisance to a stranger, who, wishing to join at all in social life, is confronted at the outset by what seems an overwhelming tax on his resources and ingenuity. A native who offers the smallest civility or present—a bunch of grapes or flowers—will remark, as he does so, "Sillau keryak"—a present is necessary.

All over Central Asia we find traces of a civilization so old that it has been entirely forgotten, and nothing remains to tell us what were the races who dwelt there or how they fell from their high estate. On the north bank of the Syr Daria, all along the valley, are numerous ruins which mark the site of former cities; and legend says that this district, now a wilderness with an occasional Russian fort or small half-savage town, was once so densely populated that from Kashgar to the Sea of Aral "the nightingale could fly from branch to branch, and the cat walk from housetop to housetop." No investigations have as yet given a clue as to the identity of the once busy dwellers in this fertile valley, nor why their towns fell into decay. The country is quite capable of supporting a population; in summer, plants and flowers of many varieties bloom on the steppes, and the brush which grows on the river banks forms a cover for quantities of pheasants, geese, partridges, and other game.

Nearly all the tribes who, until the Russian era, possessed the soil in Central Asia, date themselves back to Genghiz Khan; but an account of his conquests, given by a Chinese statesman who accompanied that warrior during his progress West, in the early years of the thirteenth century, gives a description of many towns which existed then and are still standing, such as Hodjent, Samarkand, and Bokhara. It is almost certain that Central Asia was never under a homogeneous rule. Genghiz Khan, sweeping from east to west, gathered up all the little tribes and destroyed many ancient kingdoms; but he immediately divided his immense territories between his sons, and they, when their turn came, did likewise, so that the family of Genghiz became a sort of hereditary aristocracy over the whole of Central Asia. Thus, among Kirghiz, Kara-Kirghiz, Kalmuks, Uzbeks, and all tribes which have any of the Mongol element, the "white bones" still love to boast of their descent from the conqueror. When one considers the number of races which have met, amalgamated, or in many cases simply settled down side by side in Central Asia, one cannot be surprised at a certain amount of confusion in their method of reckoning time. Simplest of all, the Kirghiz, having no era from which to date their years, use a twelve-year cycle, and give to each cycle the name of an animal, the names being arranged in a certain sequence. The day of the year is not regarded at all, every one born in the same year being considered as of the same age. The Kirghiz day is divided into four parts—sunrise, eating time, midday, and sunset. Seven days make a week, or atna, while the year is divided into twelve solar months, bearing names corresponding to the signs of the zodiac in Arabic. This calendar is far more complete and sensible than that now being introduced by Russia—the Julian, which is already more than twelve days out of its reckoning. Besides these zodiacal names, the Kirghiz, like all simple people, have given titles to the months descriptive of their occupations at different times of the year; and, much as the English laborer talks of sowing time, harvest, and hay harvest, the nomad speaks of lambing time, mare milking season, and the slaughtering season. The Kirghiz are well acquainted with the stars, by which they steer their path in the desert, as well as using them to calculate time. The same solar year, with twelve months named after the zodiacal signs, is in use among all agriculturists, the months having in Tashkent alternately thirty and thirty-one days, while the last month has in ordinary years only twenty-nine, with an extra day every four years. In other cities another system is adopted, rather less regular, and containing one month of thirty-two days and two of twenty-nine—a method common to agriculturists in Persia as well as Central Asia, and in the former country also used by the Government in the assessment of taxes. A rhyme, resembling our own "Thirty days hath September," is commonly used in both countries to keep the different days of the month in the memory. There is also the ordinary Mussulman calendar, consisting of a lunar year, used in all religious documents and by the educated classes generally, and since the Julian calendar has been introduced by the Russians, great confusion has inevitably ensued.

Such, briefly, are the conditions of life and main characteristics of the people of Russian Central Asia, who, by their incorporation into the great Russian empire, have acquired an importance which could never have been theirs while they remained broken up into a number of petty States. Never, since the short period of the ascendency of Genghis Khan, has Central Asia been united under a homogeneous rule. I have not time to enter into details of the methods adopted by Russia in managing this vast territory, but it is sufficient to say that her rule, though quasi-military, is on the whole beneficent; and that, although she makes little attempt to civilize, she partly, no doubt for that very reason, succeeds in securing the peace of her new, and at first unwilling, subjects. An unswerving policy, merciless to all signs of revolt, coupled with very little interference in their lives and habits, is the golden key of Russia in her dealings with the conquered; and with this she has not only opened the gates of Central Asia for herself, but has effectually locked them against every other power.

The question of communications is one which is never absent from the schemes of Russia. What she has already done to link the far distant parts of her possessions to their sovereign and head cannot be recapitulated in this paper, nor have I time to describe the measures which are being taken in Central Asia itself. It is enough to say that Russian lines made by Russians for Russia now run longitudinally across Asia, from Moscow to the China Sea, from Batum in Transcaspia to the western gates of the Chinese Empire, and to the Herat province, the key of Afghanistan, which is the outwork of India. New lines will soon join her present Transcaspian system with the European-Russian railways and thus provide alternative routes to the present inconvenient transhipment across the Caspian. The importance of these railways in a practically riverless country does not need to be emphasized, and the rate at which these lines are carried out, especially that through Kusk southward, shows what importance Russia attaches to railway communications.—Journal of the Society of Arts.

RESOURCES OF SIBERIA.

At a conference held recently at Lyons on the resources of Siberia and its possible competition with cereal producing countries, an interesting paper was read by M. Emile du Marais, a civil engineer, who has passed many years in Russia, and is a member of the Russian section of the French Bureau of Foreign Commerce. He said that 200,000 farmers arrive in Siberia annually, the Government providing them with free transport, and giving each family the free use of 15 hectares (37½ acres) of land for a stated time. The population is now 8,000,000. Making a computation upon the basis of the population of Russia in Europe, Siberia is capable of sustaining a population of 80,000,000. The annual production of cereals in Siberia is 20,000,000 metric quintals (2,000,000 tons), of which 6,000,000 to 8,000,000 quintals (600,000 to 800,000 tons) are exported. The country can produce 10,000,000 tons annually, from 4,000,000 to 5,000,000 tons of which are subject to exportation. Siberia now exports butter to Denmark. It is estimated that she can export annually 80,000,000 francs' (£3,200,000) worth of butter, wool, leather, dried and preserved meat; and fish and tallow may figure conspicuously in her efforts in the near future. A movement is now in progress in the direction of forest preservation, the destruction having caused a scarcity of furs, blue fox, and zibelines. Siberia produces one-tenth of the world's yield of gold, and but few of the mines have been worked on account of the climate. The immense coal deposits have hardly been touched. M. du Marais, according to the United States Consul at Lyons, stated in his paper that one mine with six beds contains as much coal as all the deposits in England. The lack of transportation facilities alone has prevented it from being worked. The Trans-Siberian Railway, from an economic and political standpoint, is the greatest work of this century. It now touches the Amur, and in three years it will reach Port Arthur,

making the distance but thirteen or fourteen days from Moscow to Peking. There is annually an excess of 1,500,000 births over deaths in Russia, and Siberia is the outlet for this overflow. The black lands of Siberia form an area of not less than 50,000,000 hectares (123,500,000 acres), but high freight rates are an obstacle to the arrival of their cereal products in France.—Journal of the Society of Arts.

A GUEREZA IN THE ZOOLOGICAL GARDEN AT BERLIN.

THE unrivaled scientific collections obtained by Schillings, the hunter and explorer, on his second expedition, have created a great sensation in Berlin and elsewhere. This is specially true of the instantaneous photographs of wild animals in their native haunts and the fine collection of living animals which he brought to the Berlin Zoological Garden, the finest specimen of which is the guereza from Mt. Kilimanjaro in German East Africa, shown in the accompanying engraving.

This strange creature is quite different from the monkeys in the ordinary monkey houses, not only in appearance, but also in his life and habits. Even the attitude in which he is shown indicates that he is no common monkey, for one of those would never remain quiet for any length of time under the steady gaze of a man. It is a well-known fact that the guerezas are quiet and lazy when enjoying their freedom, sitting motionless for hours in the thick tops of great forest trees, where their presence is betrayed, so Dr. Hans Meyer tells us, not only by their bushy white tails which hang down like flags, but also by a monotonous humming, sometimes louder and sometimes softer, with which they seem to while away the time. Their peculiarities, especially their dullness, is due to the nature of their food, for the apes of the semnopithecus genus and those of the colobus genus, more particularly the guerezas belonging to the latter, of which there are many species in East Africa, are herbivorous and have stomachs which are enormous in comparison with the size of their bodies, so it will be seen that they resemble the ruminants not only in the quality of their minds, but also in the structure of certain parts of their bodies.

It cannot be denied that they are splendid creatures, and the engraving gives us some idea of the effectiveness of the beautiful white hair against the black background. The species of guereza here represented (Colobus caudatus Thos.) differs from the Abyssinian one (Colobus guereza Rüpp.) so well known since Rüppell's expedition, in that its tail is almost entirely white, while that of the latter is white only on the end.—Illustrirte Zeitung.

A GUEREZA IN THE ZOOLOGICAL GARDEN AT BERLIN.

NOCTURNAL FLIGHT OF BIRDS.

By LEANDER S. KEYSER.

DURING the period of migration many species of birds perform their aerial journeys by night. You must not suppose that this flight is confined to what are known as the nocturnal birds, such as the owls and the whippoorwills; for, as a matter of fact, almost the only species that migrate by day are the ducks and geese, and even most of them prefer to travel by night. The little birds that sing and flit about us by day, and roost at night in the bushes and trees or in grassy couches on the ground, and seem to be especially created for the sunshine—these winged creatures, when the time for the semi-annual migration arrives, rise high in the air at the approach of night, and perform journeys of hundreds of miles through the trackless darkness.

The truth of this statement may be easily proved. On almost any night of the Spring or Autumn you may hear the chirping of the feathered voyagers overhead. It is evident, too, that they arrive at a given point during the night or early in the morning, for on one day, look as you will, you may not be able to see or hear a single bird of a certain species in your neighborhood, but early the next morning you may find many individuals of that group, proving that they must have arrived some time during the night. To cite a concrete case, on April 19 of the present year not a chirping sparrow was to be seen about my premises, but the next morning a little after sunrise one of them announced his arrival by trilling his well-known aria, and I soon found that there were three or four others in my yard and the adjoining lot. Besides, at many other places in the city I heard their monotonous but pleasing trills during the day.

Here is another interesting fact: During the Fall migrations most of the large flocks are found early in the morning on the north side of the groves and timber belts, while in the Spring the reverse is true—that is, they are found on the south side, indicating in each case the direction from which they have come.

It is not to be supposed that these winged pilgrims can see their way in the darkness, except, perhaps, very indistinctly. How, then, are they able to pursue the proper course through the trackless air? No doubt they accomplish it by a sort of instinct, or a general sense of the direction in which they intend to fly at the time of starting. That this theory has some foundation is proved by the fact that, when an unexpected storm arises during the night, the feathered army is often thrown into dire confusion, dashing against obstructions far too frequently with fatal effect and giving every evidence of having lost their way.

I should like to call the reader's attention to the vast numbers of birds that are pursuing their journey above us while we are wrapped in slumber. Think of the thousands of miles of country that stretch from the Atlantic to the Pacific, and yet during the flood tide of migration you might take your stand at night at almost any point in our central latitudes and listen to the almost incessant chirping of the feathered voyagers overhead, not only for an hour or two, but from early evening to the break of day. What legions of birds! We really can form only a faint conception of their numbers.

An expert student has recently made some unique observations on the nocturnal flight of the avian hosts, and I am sure they will excite the wonder of every reader. On the evening of September 14, 1896, he took his place on a slight elevation in the vicinity of three lakes in the State of Wisconsin. The weather was chilly, with a raw southeast wind, just the kind of a night in the Autumn for a "wave" of migrants. Here for the greater part of the night he gave himself up to counting the various bird calls and studying the effect of the migratory movement above him upon his own mind.

Of course, the task he set himself must have been a difficult one, and entire accuracy could not be expected, but he tells us that he recorded 3,800 bird-calls, which made an average of 12 per minute during the time of his observations. This rate, however, was far from uniform, for sometimes he was able to record two or three calls per second, while at other times only that number occurred per minute. The flood tide for the night seemed to be reached between two and three o'clock, as during that hour he counted 936 calls.

The observer tries to give some idea of the impression produced upon his mind by the passage of the feathered army overhead. At times the air seemed to be fairly alive with birds as their calls rang out in the silence of the night, now sharply and near at hand, anon faintly and far away. There were moments when a flock seemed to be so near that their presence could almost be felt, although the darkness veiled the procession from sight. Many varieties of bird voices were recognized, the harsh squawk of a water-fowl, the musical chink of a bobolink, the fine, shrill notes of the warblers and smaller sparrows, and numerous others. More than once an entire flock came into range, and then gradually passed out of hearing, preserving a solid phalanx, like an orderly body of horsemen, as the observer could distinguish from the unity of their calls. Let me quote the following graphic description from this acute investigator:

"The great space of air above swarmed with life. Singly or in groups, large and small, or more seldom in a great throng, the hurrying myriads pressed southward. It was a marvel and a mystery, enacted under the cover of night, of which only fugitive tidings reached the listener below."

Still more interesting were the observations made by the same ornithologist and a companion a year later, this time from an observatory with the aid of a small six-inch telescope, their plan being to direct their instrument toward the moon and watch the movements of the birds across its disk. The results were exceedingly gratifying, and amply repaid them for the patience required for such experimental work; and besides, they have done valuable service in behalf of the whole bird-loving fraternity. Three nights were employed in making their observations—September 11, 12 and 13, 1897—during which they counted 583 birds passing across the face of the moon. For convenience the time was divided into periods of fifteen minutes. The highest number making the transit of the moon's disk in one period was 45. The maximum's flight was attained at about 10:30, from which time the number rapidly decreased.

Thrilling indeed was the movement of the birds across the field of vision, suggesting the rapid, undulatory motion of animalcula under high magnifying power. The time of transit varied from one-tenth to one-half of a second. In most cases the wing beats were plainly visible, although occasionally a bird passed like a flash. One bird hung for several seconds on the margin of the field of vision, poising by a rapid movement of the wings. Oddly enough, a bird would sometimes change the direction of its flight entirely, wheeling off at a right angle, suggesting that perhaps an enemy was to be evaded. Only once during each night were two birds seen to cross the moon simultaneously. This would seem to indicate that these feathered pilgrims do not fly wing to wing, but perhaps for purposes of safety remain at some distance apart, depending on their calls to prevent them from straying too far from one another or from the main body. Apparently, the currents of air would sometimes accelerate or retard the flight of the birds, while one bird was observed to move backward across the field, as if the force of the wind was too great for it to overcome. Some sailed, and others pressed forward with flapping wings, thus indicating that every condition of avicular flight prevailed.

Surprising as it may seem, the direction of the flight across the lunar disk was not always the same. The predominant direction, as you would expect, was southward, especially up to 10 o'clock, but after that the di-

versity of direction continued to increase, until it reached its maximum between 12 and 2 o'clock. "At this time the eight principal points of the compass were represented by numbers varying from three to twenty-eight, two-thirds of the whole number still maintaining a southerly direction."

The sudden changes in direction, to which reference has been made, may suggest something else besides the presence of enemies. A bird may become separated from his companions, and on hearing their calls in the distance, may make a swift detour in their direction. Toward morning the greatest variation in movement was observed, and the largest number of calls were heard, showing that some confusion prevailed in the feathered ranks and that the processionists were trying to collect their scattered forces.

Brief as was the time that each bird appeared within the circle of vision, a number of species were identified. More of the red winged blackbirds were recognized than of any other species, and next in abundance were the meadow larks, of which several flocks were seen. In addition to these the purple grackle, the sparrowhawk, the yellow hammer, and one species of duck were distinguished, while several large flocks of birds resembling gulls were seen, though their precise identity could not be determined. And what about the sparrowhawk that obtruded itself into this nocturnal company? He was "moving leisurely along in no particular direction, except that he seemed to be following the main stream of travellers." His hesitating manner showed "how well concealed were his intended victims, though he had sufficient intimation of their presence to keep him on their track."

The ornithologist to whom such frequent allusions have been made in this article is Mr. O. G. Libby, who has published the record of his researches in a late number of The Auk, and has opened up a delightful field of investigation to all lovers and students of the birds; for he says, I presume to comfort and encourage his fellow-observers, that a telescope is not a necessity for nocturnal study, as "good field glasses will show all but the smallest birds." One thing is certain, that not all of nature's secrets have been discovered, and, therefore, there still remains ample room for original research.

One cannot help speculating on the sad havoc that the owls, whose keen eyes are able to pierce the darkness, must commit in the ranks of the migrants pursuing the open airline route at night. It is to be hoped that most birds know of some method of escape from owlish talons, but just what that method may be who can tell? As for the hawks and falcons, it is a comfort to remember that they cannot see in the darkness any better than can the birds on which they prey, and are able, therefore, only to pick up a careless wanderer here and there by accident. Indeed, it is not probable that they make any assault at all upon their fellow-travelers during the nocturnal flight, because, supposing that a hawk should nab another bird, how would he dispose of it in the darkness? To eat it as he flies would be beyond his power, as that is not his way of devouring his prey; nor could he see to descend and find a perch, not knowing upon what he might alight. Even if he could descend, he would be likely to lose his way and be left behind the procession.—From the New York Times.

EXPORTS OF PROVISIONS FROM THE UNITED STATES.

EXPORTS of provisions from the United States during the fiscal year about to end will exceed those of any previous year. The total will be fully \$180,000,000, thus averaging a half million dollars a day, and surpassing the phenomenal record achieved by that record breaking year, 1899. For the eleven months ending with May, 1900, the total exports of provisions, including meat and dairy products, is \$166,707,834, against \$159,378,603 for the corresponding period of the fiscal year 1899. Of this large sum, the principal items are: Lard, with a total export during the eleven months of \$38,691,000; bacon, with a total of \$35,478,000; hams, \$18,192,000; pork, \$9,459,000; oleomargarine, \$9,409,000; and beef, \$7,555,000.

American beef is finding an enlarged market abroad, especially in the United Kingdom, France, Africa, and the Orient. Comparing the exports of the eleven months ending with May, 1900, with those of the same months of 1899, it is found that the United Kingdom increased her purchases of canned beef from \$1,959,000 to \$2,937,000; France increased hers from \$31,057 to \$117,254, while Germany showed a slight decrease, the value falling from \$281,942 in 1899 to \$241,568, representing a shrinkage of a half million pounds in the volume of exports. To Asia and Oceanica the increase was from \$158,000 to \$190,000, and to Africa, from \$437,722 to \$1,033,700, representing an increase in quantity of export of more than \$6,000,000 over 1899. In the export of fresh beef, the principal increases are to the United Kingdom, with a total of \$26,113,970, as against \$20,930,949 in 1899, and to the West Indies, which took in 1900 a total of \$389,039, as against less than one-tenth of that amount in 1899, when the total was but \$34,027.

In hog products, including pork, hams, bacon, and lard, no marked increases occur, the figures for 1900 scarcely equaling those of the previous year. It is gratifying to observe, however, that our export trade in cheese is showing evidences of revival, the total for the eleven months showing an increase of 6,000,000 pounds, representing a value of over \$1,100,000 over that of last year. For 1899 the total was less than that of 1898, being 30,995,632 pounds, valued at \$2,705,240; for 1900 the total is 36,795,124, valued at \$3,809,853. Of this increase practically the entire amount was in our exports to the United Kingdom, whose share of the total was 33,000,000 pounds, valued at \$3,423,000, against 17,000,000 pounds, valued at \$1,500,000, last year.

PREVENTION OF RAILWAY ACCIDENTS IN RUSSIA.

EXPERIMENTS have been made at the Vershbolovo Station, on the St. Petersburg and Warsaw railway, with an invention of M. Nikolaieff, designed both to give warning and to lessen the deadly effects of railway collisions. The United States Commercial Agent at Vladivostock, in a recent report speaking of these experiments, says: "Two wrecking railroads were provided—on the first the sleepers were displaced; on the second, the rails were displaced. In both cases the stoppage was immediate by the aid of the device, without outside assistance, and without injury to the moving trains. The essential feature of the invention is an iron tube of usual construction, connected with the general system of brakes placed in front of the wheels. At the least irregularity in the movement of the train, the tube in consequence of certain cuts made on it at intervals breaks, and thus produces an immediate stoppage of the train—locomotive as well. The examining committee found that the tube fully accomplished its purpose. Such an invention is of the greatest importance in Russia, where railway accidents are of frequent occurrence." According to the official statistics the number of fatal railway accidents in 1893 was 4,548; in 1895, 5,763; in 1896, 6,107.

SHIPPING GOLD FROM THE KLONDIKE.

OUR engraving represents the boxes containing the first shipment of gold from Dawson City to the Canadian Bank of Commerce at Seattle, made in 1898. The boxes were made in Dawson City of the best materials which could be procured there. They were not specially protected, and were brought down by officers of the bank, who kept guard over them in their private cabin. The boxes now in use are somewhat different, being specially constructed.

BOXES CONTAINING GOLD SHIPPED FROM THE KLONDIKE.

A FROZEN WATERFALL.

IN the mountains waterfalls constitute one of the most attractive features of the landscape and all travelers are familiar with the "bridal veils," "butter-milk falls," etc., that are found everywhere until the whole gamut of titles for cascades and waterfalls of all description has been run, but comparatively few tourists are familiar with the forms that such falls assume in winter in the colder climates, when that which served in summer as a symbol of busy life is transformed to an object typical of absolute silence and death. We publish to day an engraving of a frozen waterfall—for which we are indebted to Der Stein der Weisen—that gives some idea of the fantastic and beautiful shapes taken by the water as it congeals.

A FROZEN WATERFALL.

To Remove Freckles.—A reliable remedy against freckles consists of equal parts of lactic acid and glycerin. The freckles are moistened with this twice a day. Allow to dry and wash off.—Wiener Drogisten Zeitung.

ANCIENT HISTORY OF COAL MINING.

THE history of coal mining, like the history of mankind, may be truly said to have its ancient, medieval, and modern periods.

The ancient period corresponds in part to the times which are usually designated as "ancient" in the world's political history, that is, from the year 1, whenever that may have been, up to about the year 1200 A. D., when we find the first authentic records of coal mining in England and Belgium and when coal began to be recognized as the object of a certain amount of commercial importance. Much of the data about this period is uncertain and what is now accepted as fairly well substantiated may be overturned at any time by new historical discoveries.

The medieval period includes the early struggles of coal for recognition as a fuel and its gradual rise as a competitor with wood until it finally became recognized as the leading fuel. This is the time included between the years 1200 and 1800 A. D. At this latter date the patents upon the steam engine expired and there was almost immediately a great impetus given to coal mining, and although progress prior to that time had been slow and uncertain the coal mining industry afterward went forward by leaps and bounds, for steam power quickly superseded windmills, waterwheels, horse engines, etc.

The following facts in regard to the history of coal mining have been gathered during a period of years, from here and there, and even if it were possible to do so it would make tedious reading to refer in every instance to the authorities from which much of the information has been taken. If others who are interested in the same subject have facts in their possession by which any of the assertions here contained can be corrected we will appreciate such suggestions and connections greatly.

Although the extended and almost universal use of coal belongs mainly to the nineteenth century, this fuel was known many centuries ago, for we are told by Solomon "As coals are to burning coals and wood to fire so is a contentious man to kindle strife." There were, within the domain of Solomon, many true coal areas, and it is possible that he may have referred to stone coal, but it is debatable whether he meant coal or merely charcoal, with the probability in favor of the latter supposition.

Some investigators would even have us go back for the first evidences of the use of coal to the stone ages, but their evidence is unreliable and doubtful, if not entirely mythical. Other investigators assign to the Chinese the priority in the use of coal, and whether this peculiar people was the first to use coal, as they were the first users of gunpowder and the mariner's compass, will, perhaps, remain a mystery for all time. Certain it is, however, that they had an early knowledge of it, long before the Christian era. Nowhere, probably, have we a better illustration of primitive methods of mining than in some of the Chinese mines of to-day, in which the methods have probably changed but little in the more than 2,000 years since Chinese coal mining first began. This same people appear to have made use, at a very early date, of cable transfers for bringing the coal which stood high upon a cliff down to a lower level, and they also seem to have been pioneers in the manufacture of briquets, for anthracite coal was powdered, mixed with a binder such as clay, earth, or sawdust, and the balls thus made were dried in the sun and then used in hand furnaces, affording a cheap fuel for the poorer classes. The actual date of the discovery and use of coal by the Chinese is of little consequence so far as the material development of the world is concerned, for although fertile in invention and the pioneers in many discoveries, the Chinaman seems soon to reach the limit of his inventive faculty and to be content with the most primitive appliances.

In the Western world coal as a mineral begins to be

first heard of about 330 B. C., in the time of Alexander the Great. About this time the smiths discovered that coal could be substituted for charcoal, and one writer, Theophrastus, speaks of stones from upper Italy and from Greece which were earths, and which kindled like charcoal, and which were used by the smiths. No specific name was given to them, but they were called anthraces or charcoals to which they bore so striking a resemblance and for which they could be substituted in so many ways. No other mention of the use of coal is made in the countries along the Mediterranean during very ancient times.

To what extent the Romans used coal is doubtful, and the argument of many that their extensive use of iron signifies an extended use of coal is not warranted, since in the history of iron making charcoal has always preceded the use of coal, and that coal was but very little dug by them is shown by the untouched seams of coal which have been found very near to their camps. Furthermore the Latin, like the Greek, contains no word for coal excepting carbo, which is similar to the Greek anthrax and which applies to charcoal. There is some evidence in the form of tools and cinders of the use of coal during the Roman occupation of England about the time of the opening of the Christian era, but even if this evidence is to be accepted as conclusive the extent to which this coal was used is unknown.

The writers during the Dark Ages observed an almost complete silence in regard to the use of coal, and, indeed, the wide expanses of forest made this pre-eminently and naturally the age of wood, and while this wood lasted there was not much likely to be done toward the discovery of coal and toward the development of coal mining.

Although it may not have been used for fuel purposes it is certain that cannel coal, as it is called in England, or the parrot coal of Scotland, was early made into ornaments and used for decorative purposes on account of its attractive appearance and susceptibility to a high polish.

It is usually stated that the first reference to the use of coal as a fuel in England was in connection with a charter given during the ninth century in connection with a lease given by the abbot and monks of the Abbey of Petersborough. Mr. Galloway in his very exhaustive history of coal mining discredits this reference and thinks that instead of coal being referred to in this charter reference was made to some other kind of fuel.

The first reference to the actual mining of coal was made in the books of the Bishop of Durham in the year 1190.

No record is made of coal mining in the Doomsday Book, and the record of the survey made under the direction of William the Conqueror was so complete that not even a pig is said to have escaped the census. Numerous references are made in this work, and also during the several centuries succeeding, to metal mining, while wood and peat are also frequently referred to, but if coal was used at all during these times it was probably only by the smith and lime burner, as the low houses without chimneys would probably have precluded its use as a fuel. Much of the confusion as to the time of its earliest use undoubtedly arises from the fact mentioned in connection with the Biblical references so often quoted, i. e., that the coal, or cole as originally spelled, meant not alone hard or stone coal, but charcoal as well.

Although the exact date of the first use of coal in England is uncertain, there is no doubt that it did begin to receive some attention in both England and Belgium about the year 1200.

The coal field of Zwickau is usually given as being the one earliest worked in Germany, and diggings there can be traced back to the tenth century. In northeastern Europe the mineral received little or no attention at all until a much later date.

The story of the discovery of coal in Belgium, although legendary, is a rather pretty story.

A certain smith was growing old, and, on account of age and failing eyesight, the other smiths of his neighborhood gradually encroached upon his business until finally the old man was reduced to great poverty. One day the poor old smith sat down in front of his hut, resigned to his fate, and expecting there to await death by starvation. Suddenly he saw a bright light and an angel appeared to him and asked the reason for his sadness. Houillos, for such was his name, answered the angel and told him that he was awaiting death because, on account of his age, he was no longer able to compete with the other smiths and to make a living. Thereupon the angel told Houillos to go over the hill and dig in a certain spot and there he would find black stones which would burn and with which he could do his smithy work and excel the others. Houillos went and followed the angel's direction, found the coal, and forthwith became the greatest smith of his country. So runs the fable, and from the name Houillos the French word houille for coal and houillerie for colliery are said to be derived.

So much for the ancient or mythical story which may interest some one even in this intensely practical age.—Mines and Minerals.

THE NUMBERING OF YARNS.

AT the opening of the Paris Exhibition, the building devoted to textile industries was in a more advanced condition than most of the others. Referring to that section devoted to yarns, Engineering, first of all, makes some pertinent remarks upon what is called in France "Numerotage," and expresses surprise that there should exist so many systems of counting, not only among different nations, but even in the same country. So great is the confusion from this cause, that the subject is to be taken up in an international congress next autumn. The numbering of yarns is an operation to determine the thickness of a given thread, and the number of "count" is the figure that defines this thickness. It is hoped that the confusion that has resulted from the different systems will be removed by the unification recommendations of the approaching congress, and a standard system of count established. Our contemporary then goes into an examination of the methods followed in France and in England, and shows the methods of conversion from one system to the other.

TRADE NOTES AND RECEIPTS.

Solid soap spirit, produced from almond soap and spirit (97 per cent.) by saturating the latter in the water bath, was recommended by Vollbrecht at this year's Congress of Surgeons, for disinfecting the hands and other parts of the skin. The skin is thoroughly brushed with the soap without any addition of water.—Pharmaceutische Zeitung.

Marloid, a Substitute of Celluloid, for industrial purposes, is produced from untanned leather boiled in oil, which is said to resemble celluloid in every particular. It shows the same texture as horn, can be easily and nicely polished on both sides, be pressed into any desired shape and stamped, and can be rendered flexible or rather elastic to a certain degree, by a special process, i. e., treatment in a salt or alum bath, or may, on the other hand, be hardened. By a proper polishing it can be made transparent and is readily cut.—Metallarbeiter.

Cements for Celluloid and Hard Rubber.—For repairing cracks in celluloid and for mending celluloid articles, a mixture of 3 parts alcohol and 4 parts ether is used, with which the fractures are coated until the edges have become warm, whereupon they are pressed together and dried for at least 24 hours.

A cement for celluloid articles is obtained by dissolving 1 part of camphor in 4 parts of alcohol and addition of an equal quantity, by weight, of shellac to this camphor solution.

Hard rubber is hard to cement. The best way is to use a molten mixture of gutta-percha and genuine asphalt as cement, which is applied hot. The fractures must be kept pressed together until cool.—Technische Notizen.

Uralite is the name of a fireproof building material which is pressed from broken-up asbestos with addition of chalk silicates, sulphuric acid, sulphate of alumina, etc., dried, saturated with glue and mineral color, next pressed in moulds, dried again, and cut into the desired size. Hence, it combines the advantages of stone with those of wood. It is incombustible, does not expand, does not warp in heat or dampness, can be nailed, pasted, riveted, is a bad conductor of heat, electricity, and of sound waves, and impervious to acid, frost, cold, and hot water. It has, it is true, double the weight of oak wood, but is excellent where resistance to weather and fire is desired. In Russia, many articles are made from uralite. Furniture, vessels, helmets for firemen, shields, sliding walls, protective constructions against radiant heat, etc. It also enters into the construction of warships, as the splintering of the wood upon the entering of missiles and danger of fire are obviated.—Dampf.

To Prepare Vegetable Parchment for Writing and Drawing.—Ordinary vegetable parchment is not suitable for writing or drawing, since India and other inks blur on it. This evil is obviated by the following process:

The parchment is saturated with a glycerin solution and in certain cases with an alum solution, next dried somewhat and then treated with size. If parchment cut in sheets is to be sized, the sheets, after having been dipped into the glycerin solution or the alum solution, are stretched on frames, dried a little, and next dipped in diluted animal or vegetable glue or painted or sprinkled with it. Among the vegetable sizes, the so-called rosin size is especially suited, but the glue made from cellulose waste-lies, or else starch may also be employed.

But, if the parchment is to be sized at or immediately after the production without having been cut into sheets, it is drawn through the glycerin solution after leaving the dried bath and after having been washed and pre-dried, and is, after a suitable desiccation, slowly passed through the size, whereupon it is dried on cylinders or in any other manner and finally glazed between zinc plates or in calenders or similarly.

By the treatment of glycerin or alum solution, the parchment is rendered pliant, and loosened, thus being enabled to take up and bind the size better.

In order to give the parchment a white color and take away its glossy transparency, the size is mixed with alumina. Likewise, any desired color may be imparted to the parchment by the addition of corresponding other pigments.—Papier Zeitung.

Preservation of Archæological Finds.—The sodium chloride present everywhere, in the air, in the soil, etc., has caused the rusting of antique metallic articles—bronze, iron, and rendered clay articles, limestone, etc.—brittle by crystallizing-out, while marble and sandstone withstand the action of sodium chloride well.

The precious rust on iron articles is of a black color and identical with iron scale. It is almost always caused by fire. For bronzes, the green precious patina is popular, which consists of basic copper carbonate and does not change further in the air, but dreaded as an enemy of the collections is the false patina, pale-green efflorescences of the bronzes, which result from chlorides and destroy the bronze in a short time.

Wood, textures, bones, and similar materials are excellently preserved in dry places, otherwise they are often found entirely destroyed.

For a preservation of antiquities, same must first of all be edulcorated with water. All stone and ceramic articles and perfectly decomposed iron and bronze objects are protected from crumbling apart by being wrapped with gauze and next lixiviated with water. The lixiviation is succeeded by a careful and complete drying of the articles, first in the air, then at moderate heat. Next, they are saturated with warm glue solution or hot paraffine. A saturation with zapon (celluloid) will also be valuable in many cases.

Rust and patina are, in the simplest, but by no means the best manner, removed mechanically or with acids.

The most thorough and best method of preserving metallic objects is the electrolytic process, by converting the metallic oxides back into metals. For this purpose the article is wrapped in a strip of zinc and laid in 5 per cent. soda lye, or it is suspended, as negative pole of a small battery, in a 2 per cent. potassium cyanide solution.

Finally, attention has to be paid that the articles are kept dry, free from dust, and with exclusion of sunlight.—Dr. Asbrand, in Zeitschrift für Angewandte Chemie.

SELECTED FORMULÆ.

Infants' Malted Food.—

Powdered malt	1 ounce.
Oatmeal, finely ground	2 "
Sugar of milk	4 "
Baked flour	1 pound.

Lemonade Powder.—

Oil of lemon	½ drachm.
Sodium carbonate	9 ounces.
Tartaric acid	10 "
White sugar, in fine powder	2½ pounds.

Rub the oil with the sugar until thoroughly taken up; then thoroughly incorporate the other ingredients, and pass the whole through a fine sieve.

Cherry Tooth Paste.—

Clarified honey	225 grammes.
Precipitated chalk	225 "
Powdered orris root	225 "
Powdered rose leaves	28 "
Oil of clove	30 drops.
Oil of mace	30 "
Oil of geranium	30 "

Chinese Tooth Paste.—

Powdered pumice	325 grammes.
Starch	85 "
Oil of peppermint	40 drops.
Carmine	1 gramme.

Tooth Soap.—

Castile soap	225 grammes.
Precipitated chalk	285 "
Powdered orris root	225 "
White sugar	112 "
Rose water	112 "
Oil of cloves	60 drops.
Oil of peppermint	7 grammes.

Dissolve the soap in water, add the rose water, then rub up with the sugar with which the oils have been previously triturated, the orris root and the precipitated chalk.

Lip Salve.—

Paraffin	49·0 grammes.
Vaselin	49·0 "
Oil of lemon,	
Oil of violet, of each	0·75 "
Carmine	q. s.

—Pharmaceutical Era.

Nonpoisonous Aniline Colors for Syrups, Confectionery, Etc.—The Augsburg (Bav.) Seifensiederzeitung recommends the aniline colors, made by the "Aktiengesellschaft für Anilin-Fabrikation," of Berlin, as absolutely nontoxic, and states that they can be used for the purposes recommended, i. e., the coloration of sirups, cakes, candies, etc., with perfect confidence in their innocuity.

PASTILLE YELLOW.

Citron yellow II	7 parts.
Grape sugar, first quality	1 "
White dextrin	2 "

LIQUID CARMINE RED.

Carmine	5 parts.
Dextrin	1 "
Water	4 "

SAP-BLUE PASTE.

Dark blue	3 parts.
Grape sugar	1 "
Water	6 "

SUGAR-BLACK PASTE.

Coal black (Kohlschwarz)	3 parts.
Grape sugar	1 "
Water	6 "

CINNABAR RED.*

Scarlet	65 parts.
White dextrin	30 "
Potato flour	5 "

BLUISH ROSE.*

Grenadin	65 parts.
White dextrin	30 "
Potato flour	5 "

YELLOWISH ROSE.

Rosa II	60 parts.
Citron-yellow	5 "
White dextrin	30 "
Potato flour	5 "

VIOLET.

Red-violet	65 parts.
White dextrin	30 "
Potato flour	5 "

CARMINE GREEN.

Woodruff (Waldmeister) green	55 parts.
Rosa II	5 "
Dextrin	35 "
Potato flour	5 "

To the colors marked with an asterisk (*) add, for every 2 kilos (4 pounds, 4½ ounces), a grain and a half each of potassium iodide and sodium nitrate. Colors given in form of powders should be dissolved in hot water for use.—National Druggist.

Preparations for Luring Fish and Game.—

Oil of rhodium	3 parts.
Oil of cumin	2 "
Tincture of musk	1 "

Mix. Put a drop or two on the bait, or rub trigger of trap with same.—National Druggist.

Chappine Cream.—

Quince seed	2 drachms.
Glycerin	1½ ounces.
Water	1½ "
Lead acetate	10 grains.
Flavoring sufficient.	

Macerate the quince seed in water, strain, add the glycerin and lead acetate, previously dissolved in sufficient water; flavor with jockey club or orange essence.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

The Utilization of Fruit in Germany.—The question of the utilization of fruit is being much discussed in interested circles in Germany, says Consul George H. Murphy, of Magdeburg. The reason for this is not to be sought in the supposition that there has been an overproduction or that producers have had any difficulty in disposing of all the fruit they could raise. On the contrary, the amount of fruit produced in Germany is much too small to meet the existing demand. The desire to increase the use of fruit, and especially of fruit products, is based on three motives:

(1) For sanitary reasons, it is deemed wise to encourage Germans to eat more fruit and fruit products, prepared in as many attractive forms as possible. This may be a sincere recommendation on the part of physicians, but its use as an argument by sellers of fruit is probably due not entirely to disinterested concern in the physical condition of the German nation, which certainly does not seem to warrant anxiety at present. If individuals can, however, be persuaded that an increased consumption of jam will favorably affect their mental, moral, or physical development, this may materially assist an important agricultural interest and at the same time have a stimulating effect on the sugar industry, which is now threatened by foreign competition and retaliation on the one hand and by overproduction at home on the other.

(2) As there is already an underproduction of fruit, an increase of its utilization will have a tendency to raise prices, and this will, of course, increase the profits of farmers.

(3) An increase in the use of conserves, marmalades, etc., means an increase of consumption of sugar in the home market, and this is earnestly desired for the purpose of lessening the surplus production, which can now be disposed of only through exportation.

A German axiom is that each branch of industry must constantly seek to increase its profits by intelligently providing for the utilization of its products and endeavoring to find new means for extending sales. No one probably thought, when the cultivation of sugar beets was begun, that this industry could ever influence and contract other branches of agriculture as has been the case. This has been rendered possible only by a scientific and intelligent policy and by subordinating, through united action, temporary individual interests to a determination to consider always and only the general welfare and development of the industry. Instead of prostituting a valuable industry for the aggrandizement of a few individuals, the German idea has been to do everything possible to establish it on a firm basis and thus provide a secure means of existence in Germany for hundreds of thousands of persons, who might otherwise be forced into emigration by their necessities.

As has been pointed out above, it is believed that fruit culture and the sugar industry have interests in common, and that an extension of the German marmalade industry will be of great value to others than those directly concerned.

This question has been investigated for the German Agricultural Society by Dr. Paul Degener, from whose report the following statements are indirectly taken:

In 1897 England imported 6,656,000 bushels of fresh fruit. Of this amount Germany supplied 27,000 bushels of apples, 23,000 bushels of pears, and 110,000 bushels of other fruit. The country nearest to England, a country which produces the best apples in the world, a country specially fitted by climate and position for fruit culture, a country in which many people are looking for new and profitable sources of income, this land supplies about three-fourths of 1 per cent. of England's imported apples, while in 1897 the United States furnished 1,808,000 bushels and Canada 1,021,000 bushels, or 70 per cent. of the entire amount needed.

ENGLAND'S CONSUMPTION OF FRUIT.

Prosperity, due to its great foreign trade, has led to the increased use of meat as food in England. The consumption of vegetable products has in like manner increased in the land of the "beefsteak eaters," and much attention is given to athletic exercise for the development of the body. While in Germany the potato is largely the principal food, the Englishman eats green salads, vegetables, and fruit.

The importance of these foods lies in their carbon hydrates and vegetable-acid salts. So long as nutritive stuffs free of nitrogen are used, the muscles do not need to draw on the store of albumen in the body. While the alkali salts of natural and artificial mineral waters which Germans use are quickly neutralized in the stomach, vegetable-acid salts oxidize to carbonic acid salts, and make the blood and urine more alkaline. In this lies the value of the use of sugar and fruit, and England has recognized this. While on the average, each person in England uses annually 40 kilogrammes (88 pounds) of sugar, the average in Germany is less than 10 kilogrammes (22 pounds). The difference in the use of fruit is about the same. Wherever it is possible to use sugar and fruit in food, this is done in England. There, jam and marmalade, unmixed or in the form of pies, tarts, etc., are eaten after all meals, and especially at breakfast. A workman regards a fruit pie as a sufficient dinner. Sweet biscuits and cakes are manufactured in immense quantities. Temperance eating houses, the Aërated Bread Company, etc., offer tea and chocolate with fruit and pies, instead of beer and alcoholic drinks. In German eating houses and hotels, drinking is almost compulsory.

The biscuit factory of Huntley & Palmers, at Reading, employs 6,000 workmen and ships daily forty to fifty double wagon loads, each of 6,000 kilogrammes (over 13,000 pounds). Supposing only 25 per cent. of this to be sugar, the amount of sugar used in a year must be at least 202,500 double centners (over 20,000 tons).

According to the statement of Mr. Matthieson, director of the jam factory of Clarke, Nickolls & Coombs, 400,000 tons of jam containing 1,250,000 double centners (225,000 tons) of sugar are produced annually in England, while the entire industry uses altogether over 3,000,000 double centners (300,000 tons). In jam and marmalade alone, each person in England uses daily 17 grammes of sugar. If Germany can, through the increased use of domestic fruit products, raise its average to 10 grammes, this will cover 10 per cent. of the entire German sugar production.

THE MANUFACTURE OF JAM AND MARMALADE IN ENGLAND.

The fruits are first stemmed in machines provided especially for the purpose; then they are cooked soft in a copper pan in order to free them from seeds and skins by passing them through other machines. This cleaned fruit is thickened by further cooking and set aside in stoneware vessels until needed. An advantage of this storing of partially prepared jam is that the factories can work uninterruptedly through the fruit season and lay aside other work for a less busy time. This is rendered possible by the sterilizing of the fruit by cooking. If time permits, the cooked fruit is sweetened with clarified sugar, fifty-six parts of sugar being used for sixty parts of fruit. This ratio varies, however, as allowances must be made for acidity, sweetness, flavor, etc. In order that the jam may remain soft enough, which would be hindered by a crystallizing of the sugar, after it is finished 10 per cent. of capillary sirup is added. In addition to this warm process for the manufacture of jam, there is also a cold one. The warm process renders possible the utilization of unripe fruit without causing danger to the health of the consumer. The cold process is used with ripe fruit. This method preserves the flavor, which is lost under high temperature and high pressure. The use of the word marmalade in England is confined to jams made of oranges and lemons, which are cooked with their thin skins, whose pectin changes the jam into a mass resembling jelly.

WHAT CAN GERMANY LEARN FROM ENGLAND IN THE MANUFACTURE OF JELLY?

Germany already manufactures so-called apple butter and plum and pear marmalade, especially in Strassburg, Coblenz, and Metz. Most of this does not, however, deserve the name of fruit marmalade, as it is made from fragments left over from manufacture of dried fruit and fruit wine. A comparison of English and German wares will reveal the difference. The English marmalade is good fruit mush and sugar. The German consists of unappetizing fragments without any sugar. In England, 10 per cent. of starch sirup is added; in Germany, 60 to 70 per cent., with its ingredients of sulphuric acid, dextrin, and gallisine. The Englishman will not even use 10 per cent. of German watery potato sirup, as this injures the quality of his jam. He gets fine starch gum from America, because it is there made from maize, instead of potatoes; because there hydrochloric acid and oxalic acid are used, instead of sulphuric acid; and because the American capillary sirup does not, like the German, contain sulphuric acid. German marmalades are accordingly mostly food counterfeits and cannot win a place in the world's markets.

REGULATION OF DISREPUTABLE COMPETITION IN THE JAM INDUSTRY.

As the consumer cannot decide whether jam contains sugar or starch sirup, it might be well to force the manufacturer to make a declaration showing:

(1) Whether more than a certain percentage of sweetening material has been used.

(2) Whether fruit refuse has been used.

(3) Whether saccharine has been used.

This alone would not, however, be sufficient, as there is a difference between the prices of taxed sugar and starch sirup amounting to about 20 marks ($4.76) per double centner (220 pounds). As, according to English and German price lists, this difference goes into the pockets of dealers alone, there appear to be two ways of stopping disreputable competition, namely:

(1) The granting of a tax rebate on sugar used under official control in the manufacture of marmalades.

(2) The imposing of a tax on starch sugar or starch-sugar sirup used for this purpose.

PROFITS OF JAM FABRICATION.

To make 50 kilogrammes of strawberry jam, 30 kilogrammes (66 pounds) of strawberries are needed, which, according to the wholesale prices of 1898, would cost 9 marks ($2.14). To this must be added 13·40 marks ($3.21) for 28 kilogrammes (61·7 pounds) of taxed sugar and 1·20 marks (28·6 cents) for 5 kilogrammes (11 pounds) of capillary sirup. The English industry calculates for 1 double centner (220·46 pounds) of jam 20 marks ($4.76) for business expenses, wages, fire, advertisements, discounts, bad payers, etc. Thus 50 kilogrammes (110 pounds) would cost 33·60 marks ($8). According to the price list of Wittrock & Co., of Hamburg, strawberry jam made in Metz cost 75 pfennigs (18 cents) per German pound (half a kilogramme), while the English marmalade of Keiller & Sons, of Dundee, costs 1·10 marks (25 cents), although in England it is sold at 44 pfennigs (11 cents). Deducting from the price per pound at the factory (36 pfennigs) 3 pfennigs for packing, we find that the German article containing taxed sugar costs exactly the same amount, while when untaxed sugar is used the amount of the tax (11·20 marks per double centner, or $2.67 per 220 pounds) remains as a profit. If we calculate at rates prevailing to-day, leaving the middlemen 6 marks ($1.43) as profit on the double centner and allowing the manufacturer 30 per cent. for profit, we find that 50 kilogrammes (110 pounds) of strawberry marmalade is still worth not more than 46·60 marks ($11.10), so that in retail trade a pound should not cost more than 55 to 60 pfennigs (13 to 14 cents). These are the prices charged in England, where untaxed German sugar is used. From all this, it appears that Germany, with its cheap fruits, ought easily to compete with England in the jam industry.

GERMAN FRUIT CULTURE AND THE ENGLISH DEMAND.

Although ripe winter wares, especially apples, are most suitable for shipment to England, there is no need of Germany restricting itself to this one fruit. It would be no mistake to send to England in future all of the proposed increased production; for, irrespective of the fact that there can be no possibility of overproduction in Germany, which now spends annually nearly 65,000,000 marks ($15,470,000) for imported fruit, the consumption of fruit in the broad strata of the population can not be increased by compulsory measures. A change of this kind must be gradual. Nevertheless, Germany has a market in England, where, as a neighbor State, it has advantages which should enable it to compete with all other countries. Germany can easily win this field; for, according to a statement of the German consul-general at London, the Berlin market throws that of London entirely in the shade. The consul-general especially advises that attention be given to strawberries, raspberries, gooseberries, currants, and plums.

So long as England continues to use German untaxed sugar while the Germans are compelled to use taxed sugar, it will not be necessary for Germans to manufacture finished marmalade, as they can send across the channel their sterilized boiled fruit as easily as they send their sugar. In this way they can avoid the hostility of the English jam factories and the German sugar tax as well.

The jam industry promises to have a favorable influence on fruit culture similar to that exerted by the sugar industry on the cultivation of beets. Consequently, intelligent attention must be given to the industry, the large fruit growers becoming also manufacturers and the small ones merchants. If this be done, the fabrication profit will mean also an increased soil profit. But to accomplish this it is necessary that Germany must produce pure, unadulterated, and good wares; for no market can be won with any other sort. Germany can do this as well as England, as the science of jam fabrication lies not in secrets nor in machinery which cannot be procured, but in energetic work with a distinct object kept clearly in view.

The introduction of the jam industry, if successfully accomplished, will supply many people with work throughout the entire year. In the manufacture of dried fruit especially, there is much waste of material which, when fresh, can very advantageously be made into jam, as it is particularly rich in pectin. The increased manufacture of fruit wine and fruit juice will also be advantageous to the fruit industry; likewise the production of nonalcoholic drinks, jellies, etc.

The German fruit industry in still unimportant, but if the German farmer can be induced to devote more energy to this branch of his business, as he did a few decades ago in behalf of beet culture and the sugar industry, he can safely count on securing a profit which can be excelled in no other way. Then Germany will be able fearlessly to meet American competition in fruit and sugar.

The Telephonograph.—The Telephonograph, a new invention in which the German Postmaster-General, Von Podbielski, is much interested, is a combination of a telephone and a phonograph for the purpose of recording messages received during the absence of the operator. This apparatus was invented by a Dane by the name of Paulsen. The person called up has only to hold the trumpet to his ear upon returning to the office, even after an absence of days to receive the message. Many inventors have tried to effect such a combination, but all failed on account of the difficulty of transferring the message on to a wax cylinder.

Instead of a wax cylindor, Paulsen used a flexible steel band in his phonograph, which is much simpler in construction than the Edison phonograph. Messages are much more easily removed from the steel band than from the wax cylinders. It is wound on two spools, moving quickly from one to the other, and coming in contact with a very small electro-magnet, switched into the circuit, which affects the steel band in such a way as to record on it any sounds that may penetrate to the phonograph. It is only necessary to cause the steel band to repass the magnet in order to have the sounds repeated. Each vibration of the electro-magnet produces a corresponding vibration of the steel band. In order to remove a message from the steel band, a magnet is passed over the surface on which the message was recorded.

The test recently made in the engineering department of the Copenhagen Telephone Company, whose service the inventor has recently entered, were surprisingly successful. Up to the present time, the apparatus records a song better than a spoken message; but the latter is, nevertheless, quite clear, and the experts who have been making experiments in cooperation with the inventor declare that it is only a question of time until the telephonograph will repeat a message as clearly as it can be heard through the most improved telephone.—Brainard H. Warner, Jr., Consul at Leipzig.

Cheese of Pasteurized Milk in Sweden.—Consul Nelson writes from Bergen, May 30, 1900:

Cheese of pasteurized milk has until lately been considered almost impossible to produce, and dairymen have been at a loss how to use the churn milk, which has been sold as feed for pigs or thrown away. A short time ago, a chemist at Stockholm—Dr. Frans Elander—succeeded in effecting a preparation that solved the above-mentioned difficulties. Owing to this discovery, which has been named "caseol," palatable and nourishing cheese, free of tubercular bacilli, can now be made from pasteurized skim milk. This preparation has, moreover, the excellent quality of rendering cheese more digestible. Several dairies in London have made experiments with caseol, with the same favorable result. I will gladly procure samples of caseol for any of our dairymen who may desire to make trials with it.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

THE GATE OF VITRÉ CASTLE.

VITRÉ is one of the most curious cities, not only of Brittany, but of France. As seen from a distance, it offers a very picturesque aspect. It is built upon a hill and encircled by dismantled ramparts commanded by towers and machicolated turrets with conical roofs and sharp gables, the remains of the old fortified castle. But the city, several times the seat of government of the States of Brittany, is gloomy enough, with its old houses, which have retained the original stamp of past ages and crowd each other timorously, and with its slovenly streets (or lanes, rather) without light or air, and as repugnant as unpleasant recollections.

But, no matter. Vitré preserves the wherewith to satisfy archæologists and artists. Among other interesting structures, it possesses a church (that of Notre Dame), the exterior of which is ornamented with a stone pulpit—a handsome specimen of the decorative sculpture of the sixteenth century. This pulpit, if tradition is to be believed, was constructed for the purpose of opposing to Calvanistic preaching (which was then all powerful at Vitré), the public preaching of Roman Catholicism.

THE GATE OF THE CASTLE OF VITRÉ.

The accompanying engraving represents the old gate of Vitré Castle, as solid as the very rock of the hill, defying the ages, and restored in but a few places. This old gate of Vitré has braved time, although the natural forces have battled against its stone and cement. But we ask, not without melancholy, whether or not it will fight to the last against the violent hands of modernism. Will not the gross ignorance of the ediles be exerted against the vestiges of the past at Vitré, as almost everywhere else, especially at Rouen? For the sake of the Brittan city, so rich in remembrances, we hope not.—Le Magasin Pittoresque.

ARTIFICIAL RAIN.

THE question perpetually arises in the popular mind as to whether man cannot produce rain or drought according as his needs may dictate. The possibility of doing this is never questioned by barbarians, who have their professional rain-makers and great medicine men, and superstitiously attribute to them all power over nature. In some parts of the Christian world it has been believed that man could bring about rain or drought, not by his own power, but by intercession with the Creator, who would, perhaps, work a miracle on his behalf. During the past thousand years miracles have been confessedly rare, and some consider it almost impious for man to dare to interfere with the operations of nature on a large scale; some even refuse to be doctored for disease.

The recognition of the truths revealed by modern science has made it evident that man can affect the weather only by understanding and making use of the laws of nature. He must do it in a natural or scientific way, not through any supernatural power or in any miraculous way. In fact, those who have a very imperfect knowledge of the laws of nature, if any at all, are often inclined to believe that there really must be some process known to science, or still to be discovered, by which man can bring abundant rain from the clouds when and where he needs it. They point to the popular belief that rain follows great battles, as proving that there is some way by which to affect the clouds—it may be through the noise of the battle, or it may be the burning of the gunpowder, or it may be a possible electric disturbance. They point to the reputed influence of lightning rods, which are supposed to draw the lightning from the skies and prevent the formation of hail.

In these and other matters there is abundant room for self-deception. It would be a great mistake to conclude that any battle by reason of its noise, or heat, or gunpowder, has had any effect in the way of producing rain, or that the lightning rods have had any effect in producing or preventing hail. The statistics that are supposed to substantiate such conclusions do not really prove anything of the kind, and yet many are deceived by them because in reasoning upon the phenomena of nature they forget to apply the simplest laws of logic, and are carried away by emotions or preconceived opinions or the plausible suggestions of others. This is not at all singular, for the history of man's progress in knowledge is the history of a long series of mistakes covering thousands and tens of thousands of years. All have to learn by bitter experience, and if science seems to have made rapid progress during the past century, that should not blind our eyes to the fact that errors may still prevail among the professional scientists as well as the rest of mankind.

In the special matter of the artificial formation of rain we heartily indorse the statement that if it is in any way possible to bring this about we must labor to discover it; in fact, we eventually shall discover the way, if there be one, but thus far nothing has been accomplished to justify us in believing that feasible methods exist or are likely to exist. Various methods have had their advocates both in Europe and America, and the citizens of the United States, with a nervous energy that is greatly to be admired, have given a full and fair trial, at great expense, to several methods advocated by men of imperious natures that would brook no denial short of nature's own experimental demonstration of their errors. Thus the rain-making by explosives was most thoroughly tested by order of Congress at an expense to the public of many thousands of dollars, and the results have been discussed sufficiently, both in public and private, to show that nothing in the way of rain, and probably nothing in the way of cloud or mist was produced. One of the first experimental trials was made quite near Washington, D. C., at night-time November 2 and 3, 1892, when a series of clouds with showers were passing over the neighboring country, and these continued right along for several hours quite independent of the bombardment. The reports from numerous observers showed that as the showers moved along over the earth's surface those in front of it reported that the noise of the exploding dynamite occurred just before the shower; those in the wake of the shower reported that the shower came before the explosion, while those in the midst of the shower, of course, heard the explosion while it was raining. There was no evidence that the explosion had any effect on the clouds. The present writer took careful observations in Washington, D. C., during the whole of this first experiment, and has also studied the subsequent experiments with explosives sufficiently to feel warranted in saying that no rainfall was produced by bombardment.

About that time we began to hear of a "famous Australian method of producing rain practised by Frank Melbourne in Australia," who was said to have recently returned home to Ohio and was experimenting in that State. Beginning at Canton, Ohio, on May 7, 1891, he subsequently went to Cheyenne, Wyo., Kelton, Utah, and was at Goodland, Kans., in October, 1891. He was known as the "rain wizard." His method consisted in locking himself in a barn, house, freight car, or other room wherein he made a fire and burned or evaporated certain chemicals, whose smoke rose through the roof out of some impromptu chimney or stovepipe and dissipated itself in the thin air. Of course Melbourne claimed that the chemicals exerted a great influence on the atmosphere and forced rain to come. Occasionally rain did come after one, two, or three days of a chemical performance, but equally often it did not come. The cases of apparent success published in his pamphlet of April, 1892, were attested by the signatures of innumerable citizens, but these attestations, although they generally state "we believe that Mr. Melbourne has done more than he promised, and has produced the rain," yet, in fact, simply amounted to a record of the fact that rain did follow within four days from the time of his setting to work, and that "we are unable to account for it in any other way." The pamphlet published by Melbourne and the free advertisement in the newspapers produced so great a popular demand for his services in the arid regions that it really was a paying investment to hire him to attend a local fair or to "operate" in any locality. The twenty-five cents admission fee to see the "operations" were sure to cover expenses. The Weather Bureau was often importuned for advice as to when he should be called to any given town, and whether the inhabitants would be justified in paying him his fee of several hundred dollars. Eventually, a prominent railroad, through its enterprising business manager, rigged up a car for his use, and during the years 1892-4 made it convenient for all the citizens on its lines of road to invoke the aid of "the rain producer." Of course, there are numerous cases in which the operations were followed by rain; those who studied the Daily Weather Map could see at a glance that these rains accorded with the general weather conditions and had nothing to do with the rain-making operations. So long as frequent rains occurred, although they were natural and were predicted by the Weather Bureau on the basis of the weather map from day to day, yet the farmers of Iowa, Kansas, and Nebraska, ignoring this fact, were sure to accredit all success to Mr. Melbourne. Apparently, it was at first a profitable enterprise for the railroad, whose general manager wrote to us as follows in August, 1894:

"The expense of the efforts has, with very rare exceptions, been our own and borne by the company. If good has resulted, the company can claim the benefit of it, and if the conditions which followed the operations would have followed them naturally, no one has been deceived except the company, because, with one or two exceptions, it has paid the bill."

Since 1894 several imitators of Melbourne's methods have occasionally been heard from. In March, 1896, Mr. W. Hazenflug, of Yates Center, Kans., was said to have patented a rain-making device—"an especially constructed gun, 14 feet long, that discharged a moisture-producing substance to a height of 18 miles and produced a shower of from 3 to 5 inches of rain within twenty-four hours at a small cost of $6.00." America is not alone in these matters; on October 23, 1893, a prominent scientific journal of France recorded that A. Baudounin ran up a kite to a height of 1,200 meters into a cloud and produced sprinkles of rain, and that he had often thus made it rain in Tunis, Africa.

During the last great drought in California, 1898-99, the citizens of one city authorized an extensive and expensive system of experiments by gases and by cannon, but were fortunately saved the necessity of actually wasting their money by the fact that an abundant rain fell naturally just before they were ready to begin their own operations.

Occasionally we still receive newspaper items reviving the old story that floods of rain were broken up by cannonading at Rome, or that rain was produced by cannonading in Italy, or that hailstorms were averted from a special vineyard that was protected by lightning rods while neighboring vineyards suffered. These are all repetitions of the same old myths or repetitions of useless experiments, and the intelligent reader may dismiss them as having no foundation. No matter how severely his land may be suffering from drought

or flood, he should seek some other mode of relief and not waste his time and money in efforts to change the nature of the clouds or the atmosphere.

In letters lately received from a gentleman in Helix, Cal., the writer says:

"I have a letter from a man in Kansas, who, during five years, made 200 experiments with the discharge of gases, and declares that in 90 per cent. of the cases they were successful, and his statement is fully confirmed by the assistant general manager of the railroad that lent him a traveling car, and, in fact, employed him. . . . Will you kindly specify what gases have been experimented with by the Government, and then I will tell you what he used. If you have thoroughly tested the same gas, then, of course, I can believe there is nothing in it. If not, then, I trust you will apply for the use of that $5,000 that was repaid into the treasury, and have a thorough test made around San Diego. . . . The present winter threatens to be another dry one, and the orchardists are in despair—it means ruin to many. The water companies say if they have to pump again they will have to charge us 10 cents for 1,000 gallons instead of 5 cents as last year. . . . I only wish to be satisfied that you have entirely overlooked the tests I name (i. e., the method of the Kansas operator.—ED.) or I would give you the facts now, but your specialists having reported that it can't be done, are, in my opinion, biased, and will pooh-pooh every one else's tests. The man in question says he used 20 tons of chemicals; that although he failed in some places he succeeded in 90 per cent. Is it likely he would have gone on using 20 tons of chemicals at his own cost, if it was a dead failure? He has no motive to gain; he has made the recipe public, and why then should he lie about it? . . . The reason why nothing is heard of this man's success is obvious. As most people get all the rain they want the public does not concern itself about the matter."

The honest indignation of our correspondent at the supposed shabby official treatment of a man in Kansas who has thus greatly and generously benefited his countrymen can best be met by the above given public statement of the simple facts of the case as learned by the present writer at the time of their occurrence, and we publish them for the benefit and guidance of all. It is not necessary for the Weather Bureau to try Mr. Melbourne's chemicals. He himself and his railroad company did that for us to perfection. The full official statement of his results day by day during May, June, July, and August, 1892, are now before us, and justify the statement that rain followed when the weather conditions were favorable for rain and when the local Weather Bureau man, with the weather chart before him, would have predicted local rains, such as occur in the summer time, without any regard to the chemical operations. Moreover, our correspondent may rest assured that the twenty tons of chemicals and other expenses were paid for by the railroad company, as shown by the above quotation from the letter of the general manager, probably until it was found that the company was losing too much money by the operation, and perhaps also a little self-respect in perpetuating the delusion.

We may add further that if the Kansas recipe of chemicals appropriate to the production of rain is known to our correspondent at Helix, and if he and his neighbors wish to try the experiment during the next season of drought, there is certainly no reason why they should not do so. It seems absolutely necessary that the experiment should be tried over and over again, generation after generation, in order to show its folly to those who can only be guided by their own personal experience.—Monthly Weather Review.

TILES AND MOSAICS IN VENICE.

THE tile and mosaic industries of Venice and the surrounding region are not carried on by the same persons or in the same manner, and in any study of their manufacture they must, therefore, be considered separately. It should also be borne in mind that while Venice enjoys a high and deserved reputation for her arts of mural and pavement decoration, that reputation, according to the United States Consul at Venice, is for the most part of the past. It is true that the mosaics of modern Venice are to be found now in nearly every city of importance, but this is largely due to the traditions of Venetian glass making. There are in Venice two important houses concerned with decoration by mosaic—the Società Musiva Veneziana and the Compagnia Venezia Murano. Of these the former devotes itself exclusively to decoration. The material employed is the Venetian vitreous mosaic obtained by the Società Musiva Veneziana from the glass factories of Murano. Thus the company has nothing to do with the manufacture of the mosaic itself, and does not deal in mosaics as commercial products. It may not be irrelevant to note a few of the more important buildings decorated by the Società Musiva Veneziana. Among them may be named the Duomo of Florence (restored façade); the church of the Santa Maria Ausiliatrice of Turin; the church of Santa Maria Immaculata at Genoa; the tomb of Pius IX. at Rome; the Jewish synagogues of Milan, Turin, and Florence; the Church of Notre Dame de la Garde at Marseilles; the Cathedral of St. Vladimir at Kief; the Church of the Resurrection at St. Petersburg; the monument of Alexander II. at Moscow; and the Russian churches in Vienna and Jerusalem. The Compagnia Venezia-Murano differs from the Società Musiva Veneziana in that it has its own glass furnaces at Murano, and conducts the mosaic business as a department of glass manufacture. The mention of these two houses by no means exhausts the Venetian producers of, and decorators in, mosaics, but no other firm works on a parallel scale. The many glass factories manufacture mosaics as a side product. The industry is not one to be considered by itself—hardly even in the case of the Compagnia Venezia-Murano—and among the smaller establishments is of the most incidental importance. As to buildings noteworthy for their polychrome decoration, that is a subject rather to be studied from the literature of architecture, for in spite of the wide admiration for Venetian mosaics, not one modern edifice in Venice bears that decoration, with the exception of the headquarters on the Grand Canal of the Compagnia Venezia-Murano, if a restored Renaissance palace may by courtesy be called modern. The peculiar situation of Venice, however, renders the erection of modern buildings more difficult and more undesirable than in other cities, which may account for the neglect by the modern Venetians of the polychrome decoration so much affected by their ancestors. There cannot be said to exist in Venice an industry for the manufacture of marble mosaics for pavements. There is desultory activity in this direction occasioned by the necessity of repairing the floors of St. Mark's, and other buildings notable for their decoration in this respect, but nothing in the way of an organized business. The manufacture of tiles is something quite apart from that of mosaics, and in the city of Venice is unknown. There is a tile factory in the district of Veneto, and one in the city of Treviso, which makes tiles by a secret process from clay found in the region of Treviso. The qualities claimed for this tile are resistance to friction, extremes of temperature and chemical action. It is also very light and less expensive than marble flooring. In appearance it is glazed and colored throughout with plain tints. The tiles are intended for any kind of interior or exterior pavement, but on account of their pleasing appearance are excellently adapted for simple and mural application. The highly-decorated tile is not produced in Venice. A number of small establishments manufacture paving tiles of different cements or clays. The supply, however, is purely for local use and exceedingly limited, while the methods of production are altogether primitive. In general it may be said that the cost of production both of tiles and mosaics is small. The clays and cements for the tiles are obtained from the neighboring districts, the "smalts" of mosaic come from the adjacent glass factories, and labor is cheap. In the Venice glass and mosaic factories woman and child labor are largely employed, and the working day is about eleven hours.—Journal of the Society of Arts.

THE CAMBODIAN TEMPLE AT THE PARIS EXPOSITION.

THE PAGODA OF CAMBODIA AT THE PARIS EXPOSITION.

ONE of the most interesting of all the French colonial exhibits at the Paris Exposition is that made by Cambodia. This is an exact fac-simile of the hill of the Pnon Penh, crowned by the King's pagoda, a splendid building all gold, bas-reliefs and statues. A profusion of rich ornamentation and an inextricable medley of allegorical figures and lotus flowers, garlands and fantastic animals, half monsters, half deities, give this pagoda a remarkable appearance. Rocks and groves protect the approach to the inaccessible deity, and even the Brahmas and true believers can only reach the summit by climbing a splendid staircase of over forty steps. At the threshold of the building Buddha, in the beatific repose of Nirvana, seems to be awaiting offerings. The architect has tried to give the general effect of that characteristic grandeur which is found in all of the famed pagodas. Rows of wonderful decorations, in which figure the flora and fauna of the forests, mythical creatures of the Buddistic Pantheon, cover the friezes and the bas-reliefs invest the frontage and its accessories with that kind of extravagant and bold beauty which appears to be the result of combining the arts of India and Laos. In order to impart the appearance of isolation and mystery suitable to a temple, a garden filled with lovely flowers from the Far East winds around the base of the hill of Pnom-Penh, surrounding the house of the god, with a fence of exotic foliage. A Cambodian village formed of huts built on bamboo piles imparts an element of life and activity to the Asiatic quarter of the Exposition.—For our engraving we are indebted to The Illustrirte Zeitung.

TELEGRAPH WIRES ON GLACIERS.

IN a communication to the French Academy, published in a recent issue of "Comptes Rendus," the veteran astronomer, M. Janssen, gives some interesting information as to the insulating power of glacier ice, as developed in the telegraph work conducted in connection with the Mont Blanc observatory during the past year. These investigations were conducted by MM. Lespieau and Cauro, and the unfortunate feature of the work was the fatal accident to M. Cauro almost at the outset of the experiments.

The undertaking upon which the studies were made consisted of the connection by wire of the summit of the mountain with the Grands-Mulets, and the interesting feature of the experiment was the fact that the naked wires were permitted to lie directly upon the surface of the glacier, without any support or insulation.

The wires used were the regular French government standard of galvanized iron, 3 millimeters in diameter, and the length of the line was about 1,700 meters, or a little over a mile, this being the distance between the terminals, and hence the length of each half of the circuit. The wires were laid directly upon the surface of the ice, being about 5 meters apart, no insulation being used even where they came in contact with the rocks for a few meters at the Grands-Mulets terminal. Having been found to operate satisfactorily with the telegraph instruments, they were tested for resistance and insulation. These measurements showed that the insulation was almost perfect. Galvanometer deflections on the line at points distant 360, 600, and 1,700 meters from the lower station were practically identical with those at the terminal, and the resistance of the line, as tested by Wheatstone bridge, was found to lie between 56 and 57 ohms, while with perfect insulation it would have been but 59 to 60 ohms, so the loss was insignificant.

The results of these experiments, while perhaps of limited application, may yet prove of much importance in mountain exploration work, since it is shown that telegraph wires may be laid over the ice in the trail of an exploring or military party with but little labor or cost.

One point which must not be overlooked in this connection is the influence of cold upon the battery. The

resistance varies notably with the temperature, probably due to the reduction in strength of the chlorhydrate of ammonia caused by deposition of the salt. Down to temperatures not lower than 16° C. the electromotive force remains practically constant, after which the solution slowly freezes. When the mass had become solid the temperature continues to fall, and the resistance increases enormously. These points must be taken into account, especially in connection with electrical measurements made at low temperatures.

In view of the fact that the surface of a glacier is always in slow motion, the permanency of a telegraph line laid upon the surface of the ice cannot be insured. M. Janssen promises some future data upon this point, which must necessarily involve observations made over a considerable period of time, but as such lines will probably be laid only for temporary purposes, this is not a matter of fundamental importance.—The Engineering Magazine.

SOME TWENTIETH CENTURY PROBLEMS.*

It is never a bad plan to improve an anniversary occasion by comparative observations. In commercial and manufacturing lines, short intervals of time are marked by balancing books and checking off accounts, and an inventory is taken at the end of the year without exception. And so it happens that I am going to recognize to-day the fact that we stand at the end of a century, and what I have to say will be influenced to no small extent by the recognition of that fact.

Under ordinary circumstances, with this in mind, I could hardly avoid following the commercial example at the end of the year, and taking an account of stock, balancing accounts, and ascertaining the advance or retrogression in our branch of the scientific world during the period of time that represents three generations of human beings. I do not intend, however, to do this, partly because I do not wish to weary an audience with all that ought to be passed in review in such an important anniversary summation, and partly because, a few years since, Prof. H. Marshall Ward, in resuming the botanical progress of the Victorian Era, gave the more important facts, while the vice-presidential addresses of several recent years before this Section have dealt with important advances in botanical thought in different directions, and of the progress of the early part of the century Sachs has given a sufficient epitome. I propose, therefore, that we shall consider the inventory and balance sheet as in hand, and that, like the thoughtful business man who has closed his books for the year after noting what he has on hand and what the balance sheet shows, we shall take a general view of the situation, in the hope that some hint of economy or conservatism or changed method may suggest itself as we do so, by which the work of the new century may be furthered.

I have felt some interest in looking over the present trend of botanical thought, as evidenced in a few recent journals and in the advance programmes of this association and the affiliated societies devoted to subjects in which botany figures directly or indirectly. Neglecting strictly economic botany, I observe that taxonomy and descriptive botany lead (42 per cent. in the particular examination made), followed at some distance by morphology and organography (25 per cent.) and physiology and ecology (20 per cent.), while the much smaller remainder (13 per cent.) consists in nearly equal parts of vegetable pathology, phytogeography and floras, and the evolution of plants either in a state of nature or under the hand of man. Though the percentages may vary considerably, the general distribution indicated above would probably apply in the main to the prevalent activity of purely botanical research.

A hasty scrutiny of not far from a thousand periodical publications received at the library of the Missouri Botanical Garden, and all containing at least occasional articles on pure or applied botany, shows, as might be expected, that the percentage of journals restricted to one branch of botany is much smaller than the average percentage contents of the current journals or programmes. Even where botany is largely or exclusively represented, the contents of journals are usually very heterogeneous. Notes or longer papers on local floras or on the characters of one or a few species largely preponderate, and there are only a few journals which concern themselves entirely or chiefly with any other single component of botanical knowledge. Among these, vegetable pathology, and economic botany in one or other of its subdivisions, assume a comparable position with morphology and physiology, though, for the reasons stated, all are relatively lowered with reference to taxonomy, as compared with current papers included in the journals. Phytogeography and evolutionary matters appear to be more suitable for books than the other main subjects excepting floras, and they do not appear to have led as yet to the establishment of journals specifically devoted to them.

The preponderance of taxonomic work as indicated by publications calls for a little consideration. Human interest in plants, as in nature generally, appears to have begun in most cases by the observation of useful and injurious or mysterious things; but before the information of the individual could become public knowledge it was necessary to mark differences between things and to name or otherwise designate them intelligibly. It is, therefore, natural that taxonomy and nomenclature, in one form or other, and however they may have been designated, should have played an equal part with economic observation in even the earlier studies of plants; and it is not at all surprising that the first real science of botany should have been developed along these lines, nor that the awakening interest in other lines of botanical study should have failed as yet to attain an equal position as regards the number of botanists concerned with them.

It is also a very natural thing that the abstract idea of the distinguishable groups of individuals that have been called species should have been ultimately all but personified, and erected into something supposed to have been realities, divinely established and immutable. Even those of us who have not passed middle age were alive when, as one of my geological friends has expressed it, a species was treated almost like a thing that had legs and could walk; and even the younger of us have seen the idea grow, from Darwin and Wallace and Huxley and Gray, through the scientific circles into the world at large, that heresy and atheism are not necessarily implied in the belief that existing species are descended from different earlier species, and that their descendants, in all probability, will be considered as yet other species.

If the incident had been closed with a general acceptance of this idea of the mutability of species, we should probably have been spared some trouble which we are now experiencing and which we are actively accumulating for transmission to our followers on the stage; but the change in the theoretical way of viewing the question of species has involved many practical changes in the way of treating them.

In some pliable groups, the expert plant breeder is quite willing to take an order for a non-existent garden form that differs as much from all of the named and classified plants as one species does from another in nature, and, though he may not give a bonded guaranty that it will not revert to some other form after a few years, it is quite likely to transmit its characters for a considerable if indefinite time if bred true, a condition less readily applied in the garden than among species in a state of nature, but scarcely more negligible in the one case than in the other. Whether or not we are to call the most distinct cultivated forms, some of which have been deliberately evolved by the gardener and some of which have originated as sports or sudden variants of either wild or cultivated plants, species, is rather a matter of agreement than anything else, for such as are capable of perpetuation by ordinary natural means constitute, in fact, groups of similar individuals of common origin, reproducing their kind, which is about all that can be said now of natural species.

The growing knowledge of the great and immediate plasticity of species has led to a considerably greater change in the way of viewing them in the abstract than even that which the introduction of evolutionary views caused. That virtually left them as real concepts, though it opened a vaguely distant question as to their beginning and end; but this brings the beginning and end so close together as to cast doubt upon the existence of species at all as definable groups having any considerable stability in time.

I can distinctly recall the thrill of surprise with which, in my student days, I heard of the belief of a distinguished German professor, that species as known in other plants and animals probably did not exist among the bacteria. I felt grateful later that the American flora contains fewer representatives of Hieracium than are found in Europe, when I saw the desperate efforts that the Germans have made to distinguish these difficult plants; and the polymorphism of the European brambles made apparent equal reason for thankfulness that American institutions are simpler also in that genus. But the rehabilitation of synonyms and varieties in all groups that the last decade has witnessed, and the increasing rapidity with which the species-splitting knife is falling upon Antennaria, Sisyrinchium, Viola, Cratægus and many other genera, have removed any such misguided thankfulness, and the further separability of natural plants, even on the old lines of specific delimitation, appears to be coming into as strong evidence on the one hand as the gardener's power to create equally distinct species or races is on the other.

There are several ways in which these admissions may affect our judgment and actions. Recognition of measurable parallelism between the operations of nature and of the gardener goes far toward removing a sentimental objection to considering as species the forms which the latter brings into being, but the treatment of both natural and garden forms on a uniform basis is likely to modify the extreme treatment which would otherwise be accorded to either. The garden forms of a given type of plant are often so numerous and so freely subdivisible as to threaten, when this is carried out, either a very undesirable polynomial nomenclature, or, what is worse, the multiplication of barely separable genera, in order that the facts may be fully expressed. It is evident that too great a multiplication of genera can but result in unwieldy complexity of system, and it is equally evident that, the ultimate purpose of the systematist being to classify and describe for others the plants which actually exist—whether in the woods or the garden—he must not be content with distinguishing between the more easily separated only, but must provide for all of the forms which either the botanist or the gardener or the user of plants for manufacturing and other purposes needs the means of separating.

We are living through a transition period in our science and should not close our eyes to the practical meaning of the changes in our beliefs. We are carrying on a movement for so classifying all groups of plants as to indicate their phylogeny by their position—or, otherwise stated, we are continuing the effort of our predecessors to secure a natural system based on real affinity rather than superficial resemblance—and at the same time we are beginning to recognize that the groups of individuals that we call species are of every-day value only in proportion to their simplicity and definability. Two years ago Dr. Farlow made a strong statement of the necessary utilitarian trend of the present attitude with respect to species. My own belief is that this will very shortly become a principal guiding thought in the work of all describers of plants, and that the old idea of something distinct in nature between the concepts of a species and a variety, which has suffered greatly in the changes that have already come about, but is still leading to diverse practices, will be eliminated as a factor of any importance.

In the address referred to, Dr. Farlow likened the efforts of the descriptive botanist to those of the happy possessor of a kodak—snap-shotting the ever changing procession of nature. It is evident that if the facts shown have changed before the picture is developed, the latter can be of value for comparison and as a record of change only; but fully as we may believe now in the changeableness of species, I think that most of us are convinced from our own experience that the span of human life is relatively short enough to prevent discouragement of the best work of which the taxonomist is capable, if, as we are more and more coming to believe necessary, it be conformed to utility as its first purpose—a purpose not at all inconsistent with phylogenetic expression.

One of the questions of daily growing interest and importance is that of the authentication and preservation of type material in descriptive natural history. It is probably and unfortunately true that many more species have been described originally from fragmentary and imperfect material than from adequate specimens, and it sometimes happens that the material of to-day makes possible a very satisfactory synopsis of a genus or family, although the greatest difficulty is encountered in attaching to the different species the names which were originally given to them. This, of course, is particularly true of groups in which specimens are made with difficulty or are easily destroyed, and, as with Myxomycetes, it sometimes becomes almost or quite impossible to go farther back in the application of names than some comparatively recent monographer's collections. A growing disposition is noticeable to subject what may be considered type specimens to more restricted use than was prevalent even a few years ago, and it is easy to see that with the daily increasing minuteness of classification, such preservative restrictions are likely to increase rather than diminish as time goes on. In some of the larger collections, the type material is already being removed from the general collections, and type collections are being formed. I have no doubt that a clear recognition of the meaning and importance of types, cotypes, topotypes, etc., as contrasted with ordinary specimens, will ultimately lead to the general adoption of this practice and to a prohibition of the mutilation of such specimens, even for purposes of minute study, as complete, if not as sensational, as that which the sealing of the cases containing Reichenbach's orchid types for a quarter of a century has effected in that family, possibly to the ultimate benefit of science, but certainly to the impairment of the work of to-day. What are to be regarded as types, cotypes and the like, for species, it is not difficult to see in most cases. A more debatable question, which indeed affects all the groups of plants superior to species, in which are to be expected ultimate upheavals quite as far-reaching as those which we see to-day in the lower groups, is that referring to the types of genera and still higher groups. This may form the subject of a committee report at this meeting, and it is to be hoped that conservative and sound but far-reaching and uniform action may be secured through the efforts of this committee of the Botanical Club, and of the Section.

In the vice-presidential address before this Section a year ago, Prof. Barnes, speaking from the point of view of the physiologist, who often finds plants of very diverse physiological behavior pertaining to one species of the taxonomist, expressed the belief that the plasticity of plants, concerning which much has been learned in recent years, is really so great that it is almost impossible, for physiological purposes, to group together any individuals except those growing under identical conditions; and he hazards the suggestion that the present method of naming plants binomially as species must sooner or later give place to some other and radically different method.

The dependence of the morphologist and physiologist upon the taxonomist is indeed quite as great as that of the student of geographical distribution and the cultivator of plants, and any classification and any classification and nomenclature which are to persist as of permanent value must of necessity be alike useful to all who are interested in plants, from whatever point of view. Whatever value the studies of morphologists and physiologists possess to-day comes from co-ordination and generalization in the light of the existing classification of plants, and the future development of these studies is most intimately connected with the evolution of a system of classifying and naming plants which shall at once permit of the ready determination and intelligible designation of any desired group of comparable plants—a result that alone can avert the very possible danger of a scattering of energy in the accumulation of information concerning untold myriads of individuals, the peculiarities of which, however much they may interest and occupy the student, can scarcely enter into science until co-ordinated and generalized on rational and reasonably permanent lines intelligible to all botanists.

The greater part of the species and varieties that pass the necessarily fine-meshed sieve of to-day are published and defined apart from their nearest relatives, so that their authors are commonly spared the difficulty of really arranging them in the system, and it is doubtful if some species which are now being published would really stand in the minds of their authors were the latter compelled to clearly differentiate them in a comprehensive treatment of the genus to which they belong.

Perhaps the most instructive current effort at a logical co-ordination of the groups of high and low degree is afforded by the Synopsis of the Middle-European Flora now being published by Ascherson & Graebner, who treat the broadly defined groups which Linnæus would have called species as "collective species," as subdivisions of which they then recognize species, subspecies, occasionally of several degrees, races, varieties, subvarieties and sports. To subspecies as well as species and collective species they give binomial designations, which, unfortunately, in a few cases, but not as a rule, are identical. A very good idea of the working of this system may be obtained from their treatment of the Cystea angustata of Smith, or the Andropogon niger of Kunth.

If the need of subdividing the groups of plants which have heretofore passed as species were no greater for any purposes than for the determination of, for instance, the wild plants of the Middle-European flora, it might not be worth while to follow this subject further or to modify a treatment which gives a possible trinomial for any form which the authors have desired to designate, and in the actual synopsis locates this form in its logical position. Unfortunately, however, unless botany for herborizers is to be a thing quite apart from botany for horticulturists, the general monographer of Cystopteris, Athyrium, Andropogon, Rubus or Pyrus must soon handle a far greater number of forms and subforms of all degrees than have been attempted even in the most comprehensive schemes yet attempted.

Horticulturists are trying to distinguish between

*Address of Vice-President William Trelease, Chairman of Section G (Botany) of the American Association for the Advancement of Science, given at the New York meeting.—From Science.

their more transient artificial productions, and natural forms or those which are more closely comparable with such forms. For the former they are trying with more or less consistency and real desire to secure the uniform adoption of simple vernacular names, while for the latter, perhaps with equal consistency and earnestness, they are trying to follow the practice of the botanists, so far as they can ascertain what that is. The actual result of this effort is, for instance, to recognize, in the orchard and the market, a variety of greening apples known as the Rhode Island, to which each farmer's son and each clerk in the commission house receives personal introduction as he would to a new neighbor or a new customer, and the distinguishing marks of which he familiarizes himself with as he would with those of a man whom he might want to know if he were to see him again.

This is not far different from the way in which men made themselves acquainted with herbs and simples before the day of books. It is very good so far as it goes, but it is neither scientific nor adapted to even the present complexity of that theoretical horticulture which every year is finding greater exemplification in practice. To advance on it, the gardener must fall back on the botanist, whose task will be to systematize what the gardener knows and what his own broader knowledge of plants may add. Now the simple matter becomes complicated. Pyrus Malus, for example, represents a species or collective species under which many hybrids and varieties now hopelessly jumbled are capable of arrangement in logical combinations, through which, when they shall have been made, the trained student can run down the Rhode Island or the Golden Russet with just as great facility and certainty as he can now determine ranunculus septentrionalis or Trillium viridiflorum. For the garden name of the apple, Rhode Island does very well, but for its botanical designation the Latinized name of the last fairly marked form of pyrus malus, or whatever the species may be called, is wanted. In the case of cystopteris and andropogon, already referred to, this would be given by either the trinomial cystopteris fragilis angustata or C. eufragilis angustata, in the one case, and andropogon sorghum niger or A. eusorghum niger in the other; but the actual position of either is indicated only by saying cystopteris fragilis eufragilis pinnatipartita angustata, for the one, and Andropogon sorghum (sp. coll.) sorghum eusorghum obovatus niger, for the other. I fear that the true expression of the facts in many genera, under the present system, would be likely to result either in a polynomial as long as those used before Linnæus' somewhat arbitrary but masterly and helpful simplification of nomenclature, and without the descriptive value of the old phrases, or in the erection of genera nearly on the lines of the Linnæan species.

Either of these results is unpleasant to contemplate, and we may well inquire if they represent the only possible solutions of the problem of even a much finer specific differentiation than is now prevalent. A generation ago the best botanists would not have looked with favor on a proposal to separate species on as fine lines as the more conservative botanists now see to be logical as well as desirable. Perhaps the botanists of to-day may not be prepared for even as radical a change as the separate nomenclature of collective species, species, subspecies and varieties has already brought to them; but I am not sure that the botanists of the next generation will not carry out a simplification of the present system—which by that time promises to be most unwieldy—that shall be quite as helpful as that which won Linnæus the gratitude of his followers and which we could not do without in the present state of the science.

I have been tempted to enlarge on this point and to exemplify the idea that I have, by a concrete illustration based on some genus of plants in which the number of minute forms to be distinguished is already very large; but I shall content myself by saying that the idea that I have of such a reform is strongly foreshadowed in the practice already introduced of binomially designating collective species and subspecies as well as all species; and it goes so far as the employment of binomials down to one remove from the ultimate subdivisions of cultivated plants designated by vernacular names. For many writers on the broader facts of plant distribution and plant properties, the Linnæan conception of species is and will be sufficient, and alone applicable. For such persons, for instance, the name Cystopteris fragilis or Andropogon sorghum is satisfactory. The necessary degree of subdivision will always vary according to the particular purpose and knowledge of the writer who may care to go further than this. For one, Cystopteris eufragilis will be sufficient; for another, C. pinnatipartita or an equivalent binomial; for another, C. angustata; while still another may find it desirable to specify by not to exceed a trinomial a subdivision of the latter of perhaps three or four degrees removal. The practical result that I foresee, then, is the ultimate uniform establishment of species of several grades, each binomially designated and its grade, perhaps, indicated by typographical means or the employment of a brief symbol connected with the name, unless, after the present nomenclature storm shall have blown by, as it surely will before this point is reached, it be indicated by the adoption of uniform endings for the specific names of each grade.

I can easily fancy a distinct protest at the violence that any such plan will do to our present treatment of species, and a further and greater protest against the possible modification of prior specific names in the interest of uniformity. A contemplation of the results of the current nomenclature reform makes me share in the feeling which could prompt such a protest, yet I venture to believe that the conservatism which opposed and still opposes the relatively trivial priority upheaval that was to have produced a uniformity in plant names that some botanists are still anxiously waiting, rests upon qualities that are more likely to favor than oppose a far greater and even radical change in the way of naming plants, when such a change shall have become necessary as a matter of practical utility—as it is likely to sooner than most of us suspect.

(To be continued.)

Artificial Ageing of Silk Fabrics.—To give silk goods the appearance of age, a fading in the sun is the simplest way, but as this requires time it cannot always be employed. In this case, prepare a dirty-greenish liquor of weak soap water, with addition of a little blacking and gamboge solution. Wash the silk fabric in this liquor and dry as usual, without rinsing in clean water, and calender.

If the deception is to be complete, no machine should be employed in sewing, since sewing machines were unknown at the Empire period. Where only an effect at a distance is desired, such considerations are unnecessary.—Neueste Erfindungen und Erfahrungen.

PROFESSOR PEPPER: A MEMOIR.

By EDMUND H. WILKIE, Late Royal Polytechnic Institution.

WITH the recent death of Prof. John Henry Pepper, who passed away at the ripe old age of 79 years, disappeared one of the principal of the now fast diminishing band of lecturers formerly attached to the staff of the late Royal Polytechnic Institution.

Although a man of solid scientific attainments, his name will doubtless be more familiar to the world in general in connection with the great success of the optical illusions produced by him at the Institution and elsewhere.

These illusions were not all of his own invention or arrangement, but it was owing mainly to his keen insight, his correct judgment as to the public taste, and his wonderful "showman" instinct, that they became so popular and obtained so great a notoriety.

Born in London on the 17th of June, 1821, he lectured occasionally as a young man at the Literary and Scientific Institution, Westminster, where my old friend Mr. George Buckland, his contemporary at the Polytechnic in after years, made his first bow to the public.

It appears one of the ironies of this life that the name of a sound scientific teacher and analytical chemist—as Mr. Pepper undoubtedly was—a brilliant lecturer and writer, a profound thinker and practical astronomer, to whom the phenomena and mechanism of the heavens formed a life's study, should descend to posterity as the exhibitor of a startling conjurer's trick; but such will undoubtedly be the case.

To most of the outside world, Prof. Pepper's name conveys no more information than that he introduced "The Ghost," but to those who knew him well, and had the privilege of listening to his many brilliantly successful lectures, the arrangement of this particular illusion ranks as only one of his many valuable additions to our scientific recreations.

His style of lecturing was conversational and fluent, and his elocutionary powers were of a high order, as was evidenced in his Shakesperian quotations introducing some of the illusions. His voice was clear, far reaching, and of a kind that commanded attention; while the matter of his lectures was so arranged that his hearers were led onward, step by step, until they became absorbed, and the time devoted to the subject seemed all too short.

As so many different accounts have appeared from time to time, each professing to explain how far Mr. Pepper was actually concerned in the production of the famous "Ghost" illusion, it appeared to the writer that the time was ripe to place upon record the true facts of the case, these facts having been gathered partly from personal observation and partly from information supplied by the Professor himself. Some accounts give him all the credit of the invention, and some deprive him of any merit at all, but the actual state of the case is as follows.

It was the custom at the Polytechnic to invite inventors to deposit models of their inventions in the Great Hall of the Institution, with the double purpose of bringing them before the public and also of increasing the attractions of the Institution itself.

Under these circumstances Mr. Dircks, an engineer, who had devoted considerable attention to "Ghosts," and written a book upon the subject, deposited a model of an apparatus for producing an optical illusion representing a ghost, but the capabilities of this apparatus were so limited that it remained an ingenious idea which was simply a curiosity, the difficulties lying in the way of its practical use seeming insuperable.

By Mr. Dirck's method, Prof. Pepper stated, the whole theater must be sacrificed to the ghost, only a very limited number of persons could witness the illusion at a time, and then from one portion of the auditorium only.

Mr. Pepper having inspected the model in the hall of the Institution, at once grasped the possibilities of the idea and set to work experimenting with a view to removing its disabilities and putting it into a form suited for general public exhibition.

Having succeeded in reducing the illusion to a practicable form, Mr. Pepper arranged to produce an entertainment at Christmas, 1862, founded on the novel "A strange Story," and when the arrangements were completed, a number of friends were invited to an informal show, what we should in a theater term a dress rehearsal, to inspect this novelty.

Prof. Pepper said that up to that evening he had no intention of making any secret of the means by which the appearances and disappearances were worked, but the effect upon his audience at the private view was so much greater than had been anticipated that the next morning he went to a patent agent and gave instructions for immediately taking out a provisional patent, which was afterward in due course completed.

The patent was in the joint names of Messrs. Dircks and Pepper, but I have always understood that Mr. Dircks, in the most handsome manner, abandoned to Prof. Pepper any pecuniary advantage that might accrue.

An account of Mr. Pepper's connection with this matter, which recently appeared in a public print, stated that when first exhibited the real figure was placed behind the wings, and the glass being at an angle of 45° with regard to the figure, reflected it.

This is an error; it is true that in after years when a smaller plate of glass was used that it occupied the position described, but in its original form the figures to be reflected were placed between the glass plate and the audience.

A great amount of uncertainty seems to exist with regard to Mr. Sylvester's connection with the illusion, but his addition was not a radical difference in the method of production, but simply an improvement in the method of reflection, by means of which the ghost, which had previously been confined to one spot, was enabled to roam the stage at will.

To describe these alterations in detail would occupy too much space here, so I must refer those who wish to go further into the matter to a series of articles on illusions which appeared in the columns of this journal commencing September 1, 1894, and which I had the honor of contributing for eight months.

It was estimated that during the fifteen months which this entertainment ran, no less than two hundred and fifty thousand persons witnessed the illusion at the Polytechnic, and when its popularity began to decline it was re-dressed in other stories such as Dickens' "Christmas Carol," "The Haunted Man," "The Knight Watching His Armor," etc.

Following this came a series of illusions in the arrangement of which Prof. Pepper was materially assisted by Mr. Thomas Tobin, who was secretary to the Polytechnic, not assistant to Mr. Pepper, as has been recently stated.

The Professor in introducing several of these illusions gave most of the credit to Mr. Tobin, and there is little doubt that he originated the ideas, which Mr. Pepper afterward elaborated.

It was at this period that many of the most magnificent of the dissolving view pictures and effects were introduced, as Mr. Pepper spared no pains or expense to render this portion of the exhibition as perfect as possible. The designs were prepared with care, a large number being painted in water color by Mr. Hine on a large scale, and afterward reduced by photography to 7 inches long by 6 inches high, which formed the stock size of the majority of the large slides used in the Institution. The combination of optical illusions and these magnificent dissolving views formed a most attractive class of entertainment, and for nearly 10 years Mr. Pepper, by producing a constant succession of novelties on these lines, kept the old Polytechnic Institution at the full tide of success. There was no dulness in its programme during this time, and not only was the optical department a great attraction to both the scientific and the non-scientific members of the general public, but many remarkable pieces of electrical apparatus were exhibited and explained. The then crude attempts to illuminate by electric light were demonstrated and explained, and the great induction coil was built.

This giant coil, which habitues of the Polytechnic will remember standing on the small platform in the Central Hall, was designed by Prof. Pepper and Mr. Apps, the eminent electrician, and weighed 15 cwts., the ebonite alone turning the scale at 478 lbs. The primary wire weighed 145 lbs., and was just over 1½ miles long. The spark produced by this giant coil was 2 feet in length, and was found by experiment to be sufficiently powerful to kill a sheep instantaneously.

Mr. Pepper's reign at the Polytechnic lasted about 10 years from the first production of the ghost illusion, and he resigned his post as manager in March, 1872, having during that time produced a succession of scientific novelties dressed in attractive and popular guise. During that time it was the rule, rather than the exception, to find the gangways in the large theater blocked by persons standing, and the doors and entrances filled by others standing on chairs, in order to see over the heads of those in front. The same people returned time after time, and with regard to the ghost illusion in particular, some persons were effected by a description of mania, and declared that the appearances must be due to supernatural agency.

After leaving the Polytechnic, Mr. Pepper travelled in America on a lecturing tour, and at the present moment I have before me the syllabus of his Chicago series in March, 1874. Here, however, the fame of the ghost had preceded him, and we find that he was compelled to wind up every lecture with this illusion without regard to the subject matter of the lecture.

On his return from America, the Professor produced at the Polytechnic a very elaborately illustrated lecture on "The Sun," in the course of which a large number of beautiful dioramic pictures and some very intricate spectrum experiments were exhibited.

In 1879 Mr. Pepper, in conjunction with Mr. Walker, the well-known organ builder, produced in the large theater at the Polytechnic one of the most perfect illusions with which his name was ever connected, but I believe I am well advised in saying that the illusion was absolutely the invention of Mr. Walker. It was a grand stage effect, but at that time business was certainly not being pushed at the Institution, a period of decay seemed to have set in, and the illusion did not receive the amount of attention which it deserved.

Not meeting with financial success, Prof. Pepper accepted a post as public analyst in Australia, where he lived for 10 years, from 1879 to 1889, giving also occasional public lectures, many being at the Gaiety Theater, Brisbane. He also gave a series of lectures in connection with many of the scientific societies.

At the end of that period, Prof. Pepper returned to England, where he resided until his death, which removed from our midst a personality always regarded with respect and affection by all those with whom he came into contact at the Polytechnic. A polished gentleman and a sincere Christian, he never let slip an opportunity of impressing upon his hearers that the man of science by endeavoring to penetrate deeply into the hidden secrets of nature was guilty of no irreverence, and that the idea that science and unbelief go hand in hand was totally devoid of foundation; and the writer well remembers the impressive manner in which the Professor would wind up his astronomical lectures.

With arms and eyes raised he would repeat those beautiful words of the Psalmist "The Heavens declare the Glory of God, and the firmament showeth his handwork."—The Optical Magic Lantern Journal and Photographic Enlarger.

LIEGE SCHOOL OF FIREARMS.

THERE is established in Liege an industrial school known as the "Ecole Professionnelle d'Armurerie," founded in 1896 by the city, the government, and the province, where thorough instruction is given in the manufacture of firearms. The complete course covers a period of three years, and is divided into theoretical and practical. The theoretical covers drawing, lectures on the strength and combination of steel and iron, etc. The practical consists of several depart-

ments, such as woodworking, engraving and polishing, each presided over by a competent instructor. Tuition is free, and in addition the pupil is paid 25 centimes (about 2½d.) per day, and on completing his course receives a sum equal to 35 per cent. of the sales of his finished work. The school opened with eight pupils, and at present has 115 in the different departments, which is its limit. Arrangements are almost completed for materially enlarging the buildings during the present year to provide accommodation for more than 200. Pupils from this school have no difficulty, according to the United States Consul at Liege, in securing positions at good wages. The important position occupied by the school will be realized when it is understood that about 30,000 persons in Liege alone and its immediate vicinity are employed in the firearm industry. The object of the institution is to qualify workmen for responsible positions in the different factories, since for the past few years nearly all are employed on piecework, which does not fit men for positions requiring a general knowledge of the business. This put the manufacturers at a great disadvantage, as it was becoming nearly impossible to secure competent foremen and superintendents of departments. For several centuries the manufacture of firearms has been the leading industry of Liege, and its vicinity and the city maintains an interesting museum of firearms. It is worthy of note that several thousands of the old flintlock guns are still manufactured every year at Liege for the trade in the interior of Africa, the natives preferring them to the modern guns.

THE CONDITIONING AND TESTING OF TEXTILE MATERIALS.

THE Chamber of Commerce of Paris, in addition to the consultative rôle that it performs in great industrial and business transactions, has undertaken the management of various funds that it has raised and the object of which is either to develop or promote questions that closely affect the commerce of the metropolis. Among such questions, one of the most interesting is that which relates to the "conditioning" and testing of textile materials, and more especially of silk, which, as is well known, represents a large amount of money under a relatively feeble weight, and on the subject of which it is important to prevent, through official titrations, any possibility of error or fraud.

As a general thing, there is more or less ignorance as to what the "conditioning" of silk is, and, in fact, the expression itself does not suffice to define it. All fibers, according to their nature, are more or less hygrometric, that is to say, they absorb more or less water from the atmosphere, and thus alter their own weight or "condition," and, in the case of silk and other expensive fibers, this is a serious matter. If fibers were absolutely dried by artificial means, they would become rigid and brittle, and the object therefore is not to take out all the moisture, but to ascertain whether a given sample contains more than the proper amount, and, if so, how much.

Originally, conditioning consisted in drying the fibers absolutely and then adding the proper quantity of water. But when the operations of washing, purifying, etc., were performed later on by chemical means, it was found that a certain amount of foreign matters remained in the silk, wool, etc., only to be got rid of during the processes of spinning, weaving and dyeing. Here, then, was a positive source of error and loss. In consequence of this, in certain localities and on certain occasions, not only the moisture, but also all the oily, soapy and alkaline matters were removed, but still the operation retained the name of "conditioning," while in fact it was purification.

Silk conditioning, as a public operation, began at Turin in 1750, when the King of Sardinia placed at the disposal of merchants a number of large halls each provided with four chimneys and in which an even temperature was maintained in winter by means of stoves. The silk was suspended in these halls for forty-eight hours, and transactions were based only upon the weight of the dry silk.

In 1780 hurdles for the same purpose were installed at Lyons, the drying chamber containing them were officially sealed, and at the end of twenty-four hours the silk was supposed to have reached a "good condition." This word has become so thoroughly rooted that the laboratories in which these drying operations are performed are still called "conditions" in France.

These primitive processes were gradually improved, and, instead of drying whole bales, samples were taken here and there for testing. Afterward methods and apparatus were devised that permitted of considerably reducing the time required to perform the operations. MM. Talabot and Arcet studied the question and were the pioneers in the processes employed at the present day. The "condition" of Paris was installed as long ago as 1853, and well constructed stoves were placed at the disposal of the merchants of the city.

M. Persoz, one of the professors of the Conservatoire des Arts et Metiers, and who presided over the conditioning office, close to the Bourse, until his death, greatly improved the Talabot drying apparatus in conjunction with M. Rogeat, and devised the model which exists to-day under the name of the Talabot-Persoz-Rogeat stove.

FIG. 3.—CONDITIONING LABORATORY OF PARIS.

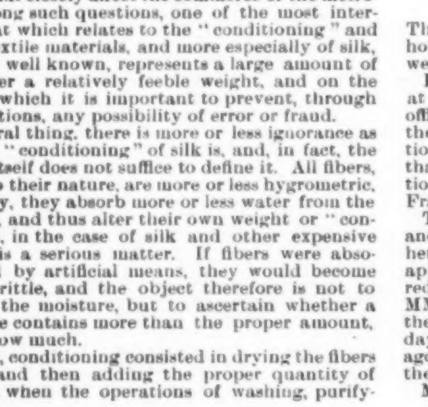


FIG. 1.—THE TALABOT-PERSOZ-ROGEAT DRYING STOVE.

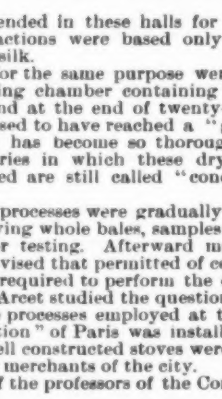


FIG. 2.—APPARATUS FOR DYNAMOMETRIC TESTS OF SILK.

As is well known, the apartments of the Chamber of Commerce were destroyed by fire during the month of May of last year and the members were obliged to take refuge wherever they could. This fire was a genuine disaster, since it destroyed the library, which contained several thousand volumes. For the "condition," however, it was a fortunate event, since it brought about its installation, with every convenience possible, in the buildings of the Bourse du Commerce. The inauguration took place on the 17th of last May.

On the ground floor we see offices and entrances at which the bales of merchandise are unloaded, along with weighing apparatus for giving the first data as to the goods. Here we see also the hall in which are installed the drying stoves, ten in number, and, alongside of it, the special laboratory in which the ungumming is effected. On the first story are the office of the director and numerous rooms in which are installed the most improved apparatus for the various tests that the silk has to undergo.

As above stated, instead of drying whole bales as in former times, samples are taken here and there. These are weighed and rendered absolutely dry at a temperature of from 102 to 108° C., and, after being again weighed, the quantity of moisture driven off is ascertained. The apparatus for performing this operation is shown in Fig. 1. The fuel employed is gas, the entrance of which is regulated by an automatic apparatus devised by M. d'Arsonval. The hook from which the sample of silk is suspended is connected with the beam of a balance of precision. The sample is weighed before lighting the gas, and in measure as the silk dries, it is seen that its weight diminishes, since the humidity evaporates. When it is found that the weight no longer varies, the silk is supposed to be thoroughly dry, and is then weighed again, this time with very great care. The quantity of moisture driven off is in this way ascertained and sales are thus based upon absolute weight augmented by the weight of the normal, or average quantity of water.

In practice, the system is to extract thirty meshes from a bale and to make these up in three lots, one of which is laid by in reserve, while the two others are dried in different apparatus and weighed. If the difference between the results is more than half per cent., then the first lot is dried in the same manner and an average taken.

These stoves are very practical. The operation of drying is performed in about half an hour. It should be stated that the samples are first passed through a preparatory stove, which may be seen to the right of the apparatus in Fig. 3, and which removes the greater part of the humidity.

In addition to the apparatus for conditioning properly so-called, the laboratory of the Chamber of Commerce contains the apparatus necessary for the other tests to which the silk is to be submitted.

The most important operation after the one that we have just described is that of "ungumming," which consists in removing the ceresine and other impurities that the silk may contain by means of baths containing a boiling solution of soap.

It is important to know what quantity of real silk, freed from foreign bodies, may be contained in a lot of goods, since such data vary greatly according to the place of manufacture, and it would be shameful to pay prices established upon the same basis, while the quantity of pure silk was not the same. Thus, certain Japanese silks contain from 14 to 17 per cent. of impurities, while those of China contain from 20 to 22. In certain specimens we find a still higher per cent., say from 40 to 45 and over.

A 100-gramme sample is taken and weighed in the conditioning stoves in order to obtain the weight of the dry silk, and is afterward submitted to two successive washings of half an hour each. It is then rinsed and carried to the stoves in order to obtain the weight of the ungummed and dried silk. The difference between the two weights gives the proportion of impurities.

Another operation that comes within the scope of the condition is the titration of silk, which consists in determining its mean coarseness. The figure obtained takes the name of "numbering." In France, the numbering of silk is legally represented by the mean weight, expressed in grammes, of a 500-meter sliver, the test being effected with twenty slivers of the same length. But the results thus obtained are always too approximate, and so commerce prefers to see the numbering converted into "grains or deniers," which give much greater deviations. By an old habit, manufacturers perform these operations with 400 ell (say 476 meter) slivers. The result is that the operations effected at the office under consideration, must be in duplicate,

one of the operations being legal and the other ordinary.

For certain industries, it is necessary to know the finish of silk, that is to say, the value of the torsion of its threads. Thus, for example, for the protection of electric wires, silk is often wound around the metallic part. It is certain that the results will vary, and in certain cases prove unfavorable, according to the twists that the manufactured silk contains. A 50 centimeter sample of silk is taken and one extremity is fixed in the immovable jaw of an apparatus devised for the purpose, while the other is fixed in a jaw that is revolved very rapidly by means of a crank and a series of gear wheels. The apparatus is actuated by hand until the threads of the silk under experiment are free and parallel. A small counter indicates the number of revolutions for a half-meter.

A special apparatus (Fig. 2) gives the dynamometric indications of the silk, and, in a single experiment, yields two results having reference to two different qualities—the elongation per meter produced by breaking and the resistance to breaking.

All these operations upon the qualities of silk are very important and greatly interest the commerce of Paris. The best proof of this is that the office, despite the cost of conducting it, is self-supporting, and the fees paid by those interested furnish a large enough income to prevent the necessity of the condition having recourse to the funds of the Chamber of Commerce. —For the above particulars and the engravings we are indebted to La Nature.

HYDRAULIC FLANGING PRESS.

THE Dalmarnock Ironworks of Sir William Arrol & Co., L't'd., is in some respects the leading bridgebuilding establishment in the world, for the greater part of the Forth Bridge, the Tay Bridge, and the Tower Bridge was built here. Our engraving represents a hydraulic flanging press built by the firm, which shows how wrought iron is contrived to take the place of castings for the frames and bodies of the heaviest tools. —For our engraving we are indebted to The Engineer.

THE CENTRAL LONDON RAILWAY.

THE formal opening of the Central London Railway, by the Prince of Wales, is an event upon which the inhabitants of the Metropolis may congratulate themselves, says The Builder. They may also, and it is to be hoped they will, entertain proper feelings of gratitude to those individuals who have successfully inaugurated so invaluable a means of communication between various centers, which measured by geographical standards are near one to another, but gauged by standards of time have hitherto been far apart.

As everyone knows, London is built above a compact bed of clay, through which tunnelling is comparatively easy by means of the Greathead shield. It is only within recent years that the value of this bed has been fully recognized as a practically unlimited field for future railway enterprise. Its utilization is rendered possible, chiefly by the late Mr. Greathead's invention, but partly also by the improvements which have been made in the construction of mechanical lifts. We believe that Mr. Greathead at one time entertained the sanguine hope that it would be practicable to introduce a complete and scientific system of inter-communicating subways for the convenience of the metropolis. When he began to experience the difficulties placed in the way of his scheme by property-owners, it became evident that the situation of any line of railway must more or less follow the course of the public streets. Land owners are but human, and however much they may sympathize with projects for the benefit of their-fellow-citizens in general, they are seldom willing to part with their sacred rights without adequate, not to say excessive, remuneration. Hence it is that most of our new underground lines run below the public highways. About the year 1892 the practical success of the City and South London Railway demonstrated the advantages possessed by low-level electric railways, and in the same year no less than six Bills for similar lines were brought before Parliament. A joint committee of both houses reported in favor of electric traction for deep-tunnel lines, and also expressed the opinion that the public interest would be served by permitting such railways to pass beneath the streets of the Metropolis without payment for wayleaves. After the contest which is always necessary in our enlightened country before any useful work can be permitted, the promoters obtained their Act, and in the year 1895 the Central London Railway Company was formed, the original engineers being Sir John Fowler, Sir Benjamin Baker, and Mr. Greathead. The Electric Traction Company, for a lump sum of rather more than three millions, undertook to construct and equip the line, and contracts for the construction were let to Messrs. Walter Scott & Company, Mr. John Price, and Mr. John Talbot. The present engineers to the company are Sir Benjamin Baker and Mr. Basil Mott.

The line follows a route which practically cuts London into two equal parts. Starting at the generating station at Shepherd's Bush, the railway passes along the Uxbridge road, Bayswater road, Oxford Street, Newgate Street, and Cheapside to the Bank terminus. The positions of the stations and their relative distances one from another, from center of the platforms, are as follows:

	Yards.		Yards.
Shepherd's Bush—		Oxford Circus...	699
Holland Park	1,012	Tottenham......	
Notting Hill Gate.	683	Courtroad...	666
Queen's road	768	British Museum	682
Westbourne Park	986	Chancery lane...	746
Marble Arch	1,288	Post Office......	1,163
Davies Street.....	642	Bank..	828

Although the extension to Liverpool Street is at present in abeyance, it is desirable in the public interest that a junction should be made with the object of bringing the Great Eastern system into closer communication with the central and western parts of the Metropolis. Any project which tends to obviate the transference of passengers from one railway station to another by cab or omnibus is obviously to be recommended. Even with the existing facilities considerable advantages will be secured. The Bank terminus places the Central Railway in communication with the City and South London line, already extended to Clapham in the south and to Moorgate in the north. At the Bank station, the Central London is connected with the City and Waterloo Railway. Another connecting link will probably be established near Oxford Circus with the Baker Street and Waterloo line, now in course of construction.

In addition to the length of 10,163 yards of double line between the various passenger stations, there is a futher section of 1,036 yards at Shepherd's Bush measured from the center of the station platform to the ends of the sidings at the depot. A length of 200 yards has also been provided beyond the center of the platform at the Bank station. Thus the total length of continuous railway, exclusive of cross-over roads at various points, is a little less than 6½ miles.

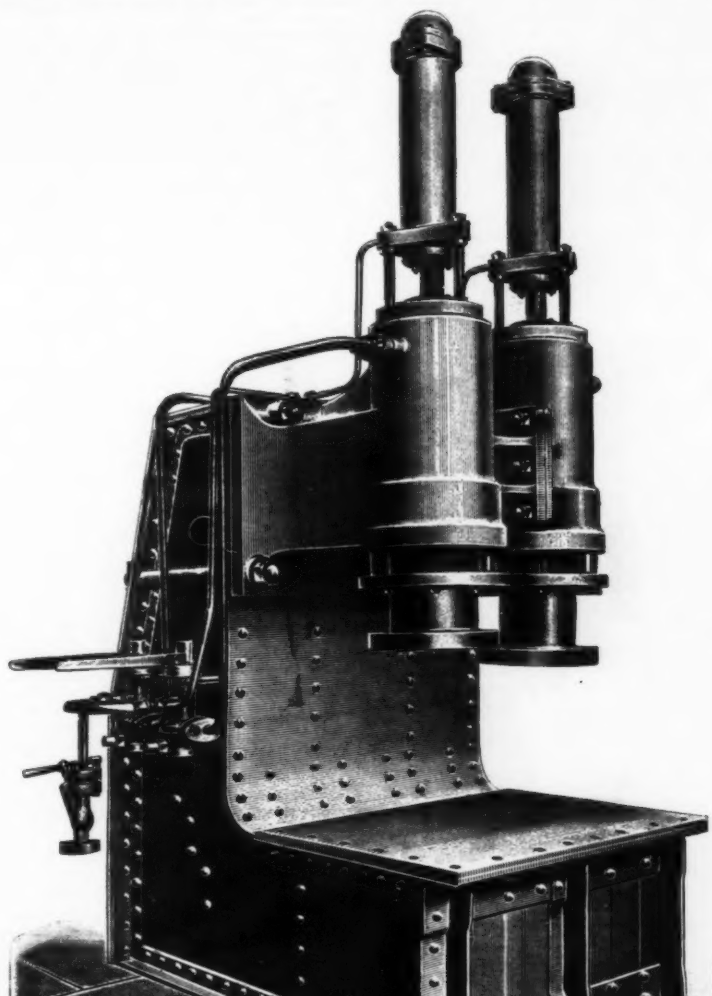
Perhaps the most interesting feature in the whole system is to be found in the Bank station and its surrounding subways. When the railway scheme was under consideration the company offered, as a compensation for the tunneling sought, to construct the much-needed subway to enable the public to cross this dangerous center without risk to life or limb. The subway, constructed just below the road pavement, is oval in form. One end of the oval is beneath the apex of the triangle formed by the pavement in front of the

Speaking in general terms, the arrangements of the new railway will be similar to those prevailing on similar lines. These particulars and the modest architectural features of the station buildings are no doubt already sufficiently familiar to our readers. It may, however, be interesting to mention a few facts relative to engineering details which are not contained in ordinary press notices.

The up and down line tunnels are 11 feet 8¼ inches in diameter, enlarged at the stations of 21 feet 2½ inches in diameter, and at the cross-overs to 25 feet diameter. At some points on the line where the curves are sharp, the small tunnels are slightly larger, being 12 feet 5 inches and 12 feet 7 inches in diameter, so that the long bogie carriages may pass round the curves.

At the western terminal station, the railway commences with the two station tunnels; a cross-over for marshalling the trains being provided at each end of the station, with a siding to the west, holding two trains, parallel to the inclined tunnel leading to the main generating station.

In starting from each station the locomotives are assisted by downward gradients of 1 in 30, the total drop caused by this gradient being about 10 feet. On the other hand, the train is assisted in coming to rest as it approaches a station by an adverse gradient of



HYDRAULIC FLANGING PRESS.

Royal Exchange, where two tangential passages ending in flights of steps give access to the subway. Another flight of steps leads to the street near the Liverpool and Globe Insurance Company's premises, and similar provision is made at the northeast corner of the Mansion House beneath the middle of what is technically termed Mansion House Street, a corridor is thrown off in a westerly direction, communicating with a passage at right angles which crosses Queen Victoria Street. At each extremity of this passage is a flight of steps, one landing the passenger near Walbrook and the other at the junction of the Poultry and Queen Victoria Street. The western corridor communicates with the terminus of the City and Waterloo Railway. The last connection with the street is on the pavement in front of the Union Bank. These subway corridors are 15 feet wide. They are lined with glazed tiles and illuminated with electric light. Immediately beneath the oval subway is another approximately equal section for pipes, sewers, and electric light wires, the diversion of which has been neither an easy nor an inexpensive operation.

The Bank station offices occupy the center of the oval, being just beneath the roadway. Five wells communicate with the underground station, each well containing a lift for the conveyance of passengers to the platform contained in the enlargements of the tunnels, 65 feet below the surface.

1 in 60. At Notting Hill Gate the surface roadway is very narrow, and the station tunnels are consequently placed at different levels, one being at a considerable distance above the other, but the tunnels slope to the same level at the adjoining stations eastward and westward.

At Queen's road there are two cross-over tunnels, with sidings of two train-lengths between the up and down lines. There are also two cross-over tunnels with a similar siding tunnel west of the Marble Arch Station, and the same arrangement occurs at the British Museum and Bank Stations. The up and down tunnels vary considerably in their relative positions; the line for the up tunnel only was laid down and surveyed on the surface. This line was not always the center line of the tunnel, but in several instances another line or set of lines was employed from which the actual center lines for both the up and down tunnels were obtained and set out underground. The longest separate length of tunnel driven was the one from Westbourne shaft to the Marble Arch shaft, the distance being over 1,200 yards, and the work resulted in an error of only ⅝ inch at the point where a junction was effected with the tunnel driven by another firm of contractors. In two of the sections boreholes were put down into the tunnel for the purpose of testing the lines, but generally the lengths were driven through so accurately that no recourse to boreholes was found

necessary. Constant attention was required to keep the shields to the proper line and gradient, and this was more particularly the case with the smaller or running tunnels of 11 feet 8⅛ in diameter. The larger station and cross-over tunnel shields demanded less attention, because the number of rams proportionately to the diameter was much greater than in the case of the smaller shields. Where sharp curves of from 3 to 5 chains radius had to be followed it was found advisable to assist the shield by slightly cutting away the clay round the cutting edge, for the purpose of avoiding any undue strain on the apparatus. In the case of the small shields on the western section of the line progress was very much facilitated by the application of an arrangement of air-driven pumps, designed by one of the works managers, Mr. A. Woodroffe-Manton, M. Inst. C.E. The pushing forward of the small shield with the ordinary system of hand pumps often occupied as long as forty-five minutes, but with the air-driven pumps no more than five minutes was required for the same purpose.

About thirty shields and a staff of 3,000 men were employed in constructing the tunnels. As usual in such work the tunnels are lined with tubes built up of cast-iron segments, and the small concentric space between the lining and the solid clay is filled with a grouting of hydraulic line and water, forced by compressed air through small holes provided in the segmental castings. In this manner the iron tunnel is immovably fixed in the clay, and, besides being perfectly protected, it is capable of withstanding any strain which can possibly be anticipated.

THE MIETZ AND WEISS PUMPING AND POWER ENGINE, GAS OR KEROSENE.

THERE are many places where a small pumping engine is required or can be used to advantage, gas or kerosene being the most available fuel for generating the power. Doubtless there are many who have occasion to use such an engine, and for that reason a brief description of an engine for pumping and power purposes, using kerosene oil or gas and manufactured by A. Mietz, 128 to 138 Mott Street, New York city, will be of interest. The three sizes manufactured have an approximate capacity ranging from 500 to 2,000 gallons per hour.

MIETZ COMBINED PUMP AND ENGINE.

The piston rod of the double-acting pump is guided by a cross-head which runs in round ways cast integrally with the pump cylinder and bored in line with the same to insure perfect alignment. The connecting rod is formed into an eccentric strap, one end thereof deriving its motion from an eccentric on the engine shaft. There are no gears to reduce the speed of the pump below that of the engine, which speed is fairly within the limits required for pumping purposes. It has been demonstrated by actual tests that even at a speed of 300 r.p.m. these direct connected pumps work smooth and without shock owing to the short strokes of the pump piston and the large ports and valves and very liberal capacity of the air and vacuum chambers. The valves are all set under a single cap which also carries the air chamber.

It is known that the starting of an engine and pump by hand taxes the muscle of the attendant most severely; but by the clutch of the Mietz and Weiss pump such starting is made very easy. The operator singly starts the engine, then pushes the clutch to engage the eccentric, whereupon the power of the engine sets the pump in motion. This single clutch mechanism is constructed as follows: The fly wheel of the engine carries a strong, steel, shouldered pin which is movable in line with the shaft, and within reach of the pumps eccentric this pin is screwed to a round disk held central by a guide rod movable also in line and in the center of the shaft. When the knob in the center of the disk is pulled, the steel shoulder pin moves out of the eccentric to turn free on the shaft. When, however, the knob is pushed in, it enters the eccentric and carries the same with the wheel. Very often these engines so connected are used either for power or pumping, and in that case a pulley is bolted to the other fly wheel for belting to shafting or machinery.

VELOCITY OF ACETYLENE DETONATION.*

EXPERIMENTS BY M. BERTHELOT AND M. LE CHATELIER.

THE velocity of the propagation of the explosion of acetylene, under different pressures and in different conditions, has been the object of our study. It is of interest, both with reference to the propagation of physico-chemical reaction in gases, and with reference to the arrangements for the practical employment of acetylene.

The acetylene was contained in horizontal glass tubes one meter in length, of interior diameter varying from two to six millimeters, and of corresponding thickness. One of the extremities was closed, the other adjusted with compressed rubber and an iron plate, which allowed of the introduction of the gas within the tube. This was previously subjected to the action of water-flowing apparatus.

The gas was admitted under different pressures varying from 5 kilo. to 36 kilo. The gas contained, according to analysis, 98 per cent. of acetylene.

The ignition was produced electrically on the piece of iron, with the aid of a charge of fulminate or chlorated powder (antimonium sulphide and graphite), weighing in general from one to four centigrammes. Strong charges ought to be avoided, because they are susceptible of causing violent undulating movements, sometimes less, but often much greater than that of the true detonation.

In some of the experiments, in order to eliminate the influence of the initial and variable period of propagation,† we preceded the glass tube with one of iron, 1·50 m. in length, at the entrance of which the ignition took place.

The phenomena were registered by the photographic method, which allowed of following all the phases accurately, at least while the ignited gas remained luminous.

In the experiments of Berthelot and Vieille on the explosive wave, the detonation was estimated with the aid of a chronograph, according to the intervals of rupture of electric currents traversing thin strips of tin arranged through the tubes. This allowed of operating with extended lengths, 42 m. for instance. The photographic method, such as we used, is designed for much more restricted lengths, but it represents the phenomena connectedly and registers all the details.

We operated in the following manner:

Opposite the horizontal glass tube, at a distance of about 8 m., the photographic apparatus was set up. The plate and its lens was fixed in a vertical frame, having slides falling at the moment of the electric ignition of the charge. The velocity of the fall was 8·30 m. per second, registered on the same plate.

The image of the flame passing through the tube was also registered on the plate in the form of a line more or less curved.

The negatives were enlarged in the proportion of 1 to 3; so that the scale of the time was 25 mm. for the thousandth part of a second.

The inclination of the tangent to this curve at a given point allowed of calculating the velocity of the extension of the explosion at that point. In the case of a uniform velocity a straight line was obtained, more or less inclined from the horizontal axis.

Such is the case with the combustion of a mixture of acetylene and oxygen, $C^2H^2+3O^2$, under the atmospheric pressure. The explosive wave is represented by a straight line, of which the inclination represents a velocity of 2,300 m. per second.

This process registers not only the propagation of the flame, but also certain undulatory reverse movements from the extremity opposite to that where the ignition takes place, at least every time that the tube is not broken, and until the instant when the cooled gases cease to be luminous.

In every case in which the glass tube was broken in the course of the acetylene explosion, its fracture—or rather, its explosive pulverization—extended back to the commencement of the tube, the phenomenon being registered faithfully, as well as the relative velocity. At this moment, too, the carbon, previously set free in the tube, burned on contact with the air, causing incandescent col mns proceeding from the broken tube. The velocity of the explosion of pure acetylene, previously compressed at 24 mm., follows an asymptotic course.

The combustion of the carbon is much more luminous than the detonation of the acetylene, the latter furnishing less light than the combustion of a gaseous mixture which no longer disengages heat. This is explained by observing that the carbon, precipitated at the time of the detonation of the acetylene, arrests the light proceeding from the central portion. The portion cooled by contact with the walls of the tube alone furnishes light to the eye.

We thought it well to make at first some trials with mixtures of acetylene and oxygen, in order to verify the characters produced by the explosive wave. This wave, as is known, is only formed regularly at a certain distance from the starting point of the ignition. Beyond, we ought to obtain, and in fact have obtained, a regular straight line; that is, a velocity of uniform propagation.

This point verified, we applied ourselves to the study of acetylene under different pressures. In every case we observed a velocity increasing in proportion with the spread of the flame. The rupture of the tube usually occurred before a period of uniform velocity was reached.

The progression of velocity varied very much, even with a gas equally compressed and a mode of ignition apparently identical. This diversity appears to proceed from what is passing in the neighborhood of the initial point of ignition; that is, the starting of the detonation. It is comprised between limits which we will describe.

In the greater number of cases the curve takes almost immediately an asymptotic course; or, more exactly, its tangent at the end of a very short passage differs but little from the value it has acquired toward the end of the passage; it tends to be almost rectilinear in the negative. Only, at the final point, at the moment of the rupture of the tube, the velocity expressed by the tangent becomes at times much greater. But the value obtained at this moment can be no longer regarded as regular.

In fact, the velocity of the compressed gas which then escapes under the atmospheric pressure from the broken tube, is added in a certain measure to that of the registered flame; at the same time the immediate combustion of this gas by contact with the air develops a more brilliant light, which conceals in part the termination of the phenomenon.

We will give some instances according to our experiments.

Interior diameter of the tube, 3 mm.; thickness 3·5 mm.; initial pressure of the acetylene in the tube 24 k.; detonation caused by a charge of chlorated powder weighing 0·04 gramme.

The velocity of the light of detonation varied quite rapidly during the first fifth of the course. Beyond, between this point and the neighborhood of the rupture, the average of the velocity was 1,450 m. per second. But in the last centimeters which immediately preceded the rupture, the tangent of the registered curve seemed to correspond to 2,160 m., the exterior flame resulting from the escape of the gas at the point of explosion, masking in part the interior light. This last value is evidently uncertain.

In many cases the variations have been much more pronounced during the whole course of the detonation. Thus, in experiment H executed in a tube of interior diameter of 4 mm. filled with acetylene under a pressure of 15 kil., the curve rose at first almost vertically; then was a little inclined; so that between the lengths 0·10 m. and 0·40 m. the average velocity was only 64 m. It increased rapidly. Between 0·80 m. and 1 m. it reached 1,320 m. The tube broke only after the flame had entirely passed through it. The bursting proceeded backward with nearly a uniform velocity of 1,200 m. per second.

The following experiment was conducted with a tube 4 mm. in diameter, filled with acetylene under an initial pressure of 21 kil. During the first three quarters of the passage the average velocity, estimated at 0·25 m. from the origin, was 180 m. At 0·50 m. it was 1,693 m. But the tube burst at about this point. The detonation did not extend forward in the tube, while the bursting of tube extended backward with a velocity of about 1,500 m. per second.

The following experiment presented a slower variation (pressure 20 kil.). From 0·10 to 0·20 m. it was 587 m.; from 0·20 to 0·50 m. it was 1,021 m.; from 0·50 to 0·65 m. it was 1,518 m. Beyond, the image of the flame was in part masked by the breaking of the tube.

In experiment A the pressure was 21 kil; the diameter of the tube, 6 mm.; the thickness 3 mm. The variation was more rapid. On the breaking of the tube it was about 1,265 m. per second. The rupture took place at half the length, and it stopped the detonation.

Following is a list of the experiments. We give only the value of the nearly regular velocity of detonation in the last region, some distance from the point of rupture.

	Initial pressure.	Velocity.	Remarks.
L	3 kil.	1,050 m..	Variation of the curve, slow.
P	10 "	1,010 " ..	Slight curve—almost rectilinear.
M	10 "	1,100 " ..	Outline nearly regular, almost rectilinear. Ignition was at the extremity of an iron tube 1·50 m. long preceding the glass tube; the iron tube was wrested from its connection with the glass.
I	10 "	1,080 " ..	
K	10 "	1,030 " ..	Outline irregular, without very rapid variations; rupture at 0·50 m. from the point of ignition.
U	10 "	1,190 " ..	Outline quite regular, iron tube 1·50 m. long.
G	12 "	1,280 " ..	Outline irregular, without very rapid variations.
H	14 "	1,210 " ..	Outline nearly rectilinear; iron tube, 1·50 m. long.

* Translated from the Annales de Chimie et de Physique.

† Berthelot: Force de Matières Explosifs, I., p. 160.

	Initial pressure.	Velocity.	Remarks.
H	15 kil.	1,320 m.	Variation of the curve extremely rapid.
A	17 "	1,280 "	
T	18 "	1,210 "	
C	20 "	1,500 "	Outline nearly rectilinear.
O	21 "	1,400 "	Outline nearly regular.
A	21 "	1,265 "	Variation of the curve extremely rapid; explosion at 0·50.
I	21 "	1,693 (?)	Same observation; same explosion.
N	24 "	1,450 m.	Outline regular and asymptotic.
E	24 "	1,260 "	Variation of the curve extremely rapid; explosion at 0·50 m.
About	30 "	1,600 about.	

We have reproduced all the results observed with exactness. But it would seem that those should be eliminated in which the variation of the curve was very rapid, and was prolonged toward the end, though at this moment the deviations from those observed in more regular curves were not very great.

By reason of these variations and the limited space passed over, this kind of experimentation does not carry the same precision as the measuring of the velocity of the explosive wave in mixtures of combustible gases and oxygen, by other methods and in tubes which are sometimes eighty-fold as long.

At all events, according to the preceding table, the propagation of the detonation of acetylene is effected with a velocity increasing with pressure, of from 1,000 to 1,600 m. per second, when the pressure ranges from 5 to 30 kil.

The spread of the detonation is always effected with increasing velocity, without being deduced to the uniformity observed in gaseous systems formed of combustible bodies and oxygen. Without doubt, the length of the tubes was too restricted to insure such uniformity. But there are other essential differences.

Characters of the Explosive Wave.—The fundamental characteristics of the explosive wave distinguish it from the sonorous wave, and generally form waves excited within a fluid by a single original impulsion, not renewed. The velocity of these waves is a function of the energy of the original impulsion. The wave which is propagated possesses a limited vis viva, defined by this velocity and the mass of the matter in motion included in the length of the wave. This initial vis viva of the fluid mass can only go on diminishing, in consequence of the communication of the motion to surrounding objects. It is, in general, too slight to raise by pressure the temperature of the moving fluid to the point where it will become luminous.

The explosive wave relates to quite different phenomena. The original impulsion determines in the fluid a chemical transformation, developing a vis viva incomparably greater and continually increasing as the wave is propagated; for the number of molecules animated simultaneously goes on increasing without cessation. A portion of the vis viva stored in the matter comprised in a length of wave is expended in reproducing on a section of the following matter mechanical conditions, especially the pressure which excites the chemical transformation of that section. Another portion of the vis viva manifests itself in the form of heat, which renders luminous the gases resulting from the transformation. In consequence, the total energy represented in the form both of mechanical movements and heat, continually increases in proportion as the wave is propagated, and this proportionally with the mass chemically transformed. This preserves its luminous brilliancy until the heat has been partially dissipated; distributed to the surrounding objects by conductibility, radiation, convection; in the case of explosives, it may be added, by the sudden expansion of the compressed gases.

Touching the detonation of acetylene, as compared with that of combustible mixtures, it is proper to state that the conditions of the distribution of the heat among the products, as well as the conditions of propagation of the wave itself, are not exactly comparable with those of a gaseous mixture furnishing only gaseous products. In fact, within a homogeneous gaseous mixture the explosive wave is produced in a system of which all the molecules tend to be animated by the same vis viva, incessantly renewed by the chemical transformation itself. The reactions of compression and dilatation, both from the calorific view-point and the dynamic view-point, are effected in all the bodies present by the same processes, on account of the gaseous state common to them. Now, it is otherwise in the case of acetylene; for a mixture of two elements is developed, of which the physical state is dissimilar; one gaseous, hydrogen, which obeys the thermo-dynamic laws of elastic fluids; the other, carbon, almost incompressible, and acting much like an assumed gas reduced to its co-volume.* Consequently, the carbon is incapable of storing the vis viva, as a gas would do in the state of elastic fluid.

This is not all. Such a system, of constitution essentially heterogeneous, cannot preserve its homogeneity. The communication of heat and of vis viva occurs according to other laws than those of a system entirely gaseous.

On account of these circumstances, the explosive wave of acetylene cannot present exactly the same characteristics as those of a mixture of hydrogen and oxygen, or any other combustible gaseous mixture. A remarkable indication in this respect is found in the highly rending force of the acetylene explosion, no glass tube used in our experiments having resisted beyond a meter, and ordinarily half a meter of length. Beyond, they have been constantly pulverized, while we have usually been able to explode mixtures of oxygen and acetylene at different pressures and in the same lengths without rupture of the tubes. The same result attended the detonating mixture of hydrogen and oxygen in a tube 43 m. long in the experiments of MM. Berthelot and Vieille.

This difference is accounted for by considering that the combustion of hydrogen and hydro-carbonated gas mixed with oxygen produces water and carbonic acid, in part dissociated at the moment and at the temperature of the explosion, and completing their combination progressively, and the thermo-dynamic phenomena with which they are accompanied during the first period of cooling, which tempers the violence of the initial shock; while the detonation of acetylene resolves it suddenly, at the first stroke, into free carbon and hydrogen.

From these developments it is seen that the propagation of the explosion in an endothermic compound gas, such as acetylene, resolved thereby into its elements, may take place with a velocity of 1,000 to 1,600 m. per second by virtue of the same thermo dynamic and chemical transformations which excite the production of the explosive wave. This opens a view of the highest interest for the general theories of chemical mechanics.

* Note by Translator.—This term, which, so far as I know, has not yet appeared in the dictionaries of any country, has been applied recently as a correction of the formulas based on Mariotte's law, or, as the English would say, Boyle's law, these two distinguished investigators, the former one of the founders of the French Academy of Sciences, and the latter one of the founders of the Royal Society, having each announced, at nearly the same time, the law that the volume of a gas, at constant temperature, varies inversely with the pressure. Modern investigators have proved the inaccuracy of the law for certain gases, and for high pressures, and various formulas have been proposed to render it exact, especially since the study of high explosives has become a science. In calculating the pressure, it has been necessary to take in account, not only the external pressure, but the internal pressure due to the attraction of the molecules. Thus from the apparent volume, a quantity must be deducted, which is called the "co-volume" by Sarrau, Berthelot and other savants. In the early formula the character V, representing the volume of the gas, not being reliable, the character v, or some other, has been introduced to represent the quantity necessary for correction, that is, the co-volume.

AMERICAN ENGINEERING COMPETITION.

II.—IMPORTS AND EXPORTS.

IT is outside the province of these articles to point out how detrimental to the commerce of a country are fluctuations in demand for commodities, more especially as there appears to be no practical remedy for the defect. To quote from an admirable address recently delivered by Mr. Charles Kirchoff, of New York: "Demand must fluctuate within wide limits so long as sentiment rules business, human follies and ambitions control public events, and the sun shines or the rain falls at times favorable or unfavorable to the growing crops." Fluctuation, however, has a considerable bearing on the probability of American competition, for, as soon as supply overtakes demand in the United States, it is the fixed determination of American manufacturers to attack us vigorously in the neutral markets of the world, and even in our own home market. A prominent American steel-maker, the head of one of the most important corporations in the country, recently declared in public that he would supply rails for abroad at cost price simply to retain a hold on the market for use in duller times.

In following out this policy Americans will rely largely on their protective tariff. It is their intention, when the reaction in trade comes, or when supply is in excess of demand, to keep up values in America by stinting the supply to the home market, and to force the export trade by cutting prices for foreign countries. That is the avowed intention of manufacturers with whom I have conversed, and the system of combines, trusts, consolidations—or whatever name may be given to these recent wholesale amalgamations of factories—will render such tactics possible. Naturally, a reversal of the protective policy of the American government to free trade principles would upset these schemes, but American manufacturers have little fear of such a contingency, and even the comparatively few free traders in the country express hardly any hope of a change in this direction, at any rate within a measurable distance of time. American producers will, therefore, possess an advantage in carrying on this species of industrial warfare, inasmuch as they will be able to attack us not only in neutral markets, but also in our own, while, owing to protection, we shall be unable to retaliate by carrying the war into their country. On the other hand, in seeking to do an extensive foreign trade, the Americans will be brought face to face with a new set of conditions, and protection may be found to be a two-edged sword, cutting both ways in a quite unexpected manner. It is one thing to carry on a manufacturing industry under the ægis of protection, in a vast and ever-expanding country, surrounded by a fiscal ring fence. It is quite another thing to go abroad and meet foreign competition on equal ground.

These considerations, however, may easily lead us too far afield, and it would certainly be out of place here to dwell on the arguments for and against free trade and protection—a question we settled for ourselves more than two generations ago. It may be well, however, for our present purpose to state the elementary contention of the American protectionist. He claims that the manufacturing industries of a new country need defense against competition to give them a fair start in the world. An instance will best serve to illustrate the principle. When I first visited the United States, now a good many years ago, there was a heavy duty on glass, and, among other things, the windows of the railway carriages were very inferior. This furnished a text for the condemnation of protection. "It was unfair to the general public to deprive them of the pleasure of looking out of the window in order that a few glassmakers might make money. Good, clear British glass, without flaws or wrinkles, could be imported at a lower price than the inferior home product." An American friend, to whom I expressed these views, acknowledged their force. "But," he said, "we are young; it is our time to make sacrifice. The extra price we pay, together with the inconvenience of bad glass, are as invested capital enabling us to establish a glass industry that will some day be able to run alone."

Of course, the argument was open to reply, but the fact remains that the railway cars now being built in America have windows clear and without blemish, as those of other countries. Moreover, the United States have a flourishing glass industry. What American prices are, relatively to those of other countries—whether the Americans are still "investing capital"—I am not aware; but it is a fact that there is an increasing export trade in American glass, amounting during 1898 to close on a quarter of a million sterling. On the other hand, it should be stated that the imports of glass to the United States still exceed the exports in value, but they are dwindling rapidly, the figures for 1898 being less than half what they were in 1893. Very little of even such glass as is imported comes from the United Kingdom, most from Germany.

In no other important industry have the Americans made more rapid strides than in iron and steel manufacture and the engineering trades. Figures have previously been quoted showing to what extent America has surpassed the United Kingdom in bulk of pig iron produced, and it is now proposed to give some further particulars of the manufacture.

According to the last annual report of Mr. James M. Swank, the general manager to the American Iron and Steel Association, the United States made, in 1898, 11,773,934 gross tons of pig iron. This figure has already been given. Of Bessemer steel ingots 6,609,017 tons and of open hearth steel 2,230,292 tons were produced. There were rolled in all 8,513,370 tons of finished iron and steel, including rails, during the same year. It has also been previously shown that the British production of pig iron was close on 3,000,000 tons less than that of the United States during the year named, while for 1899 the returns, when they appear, will show a greater disparity. In Bessemer steel ingots our product fell short of that of the United States by the enormous amount of 4 849,631 tons, our output for the year 1898 being only 1,750,386 tons. In open hearth ingots we had some advantage, our total reaching 2,806 600 tons, or 576,308 tons in excess of the American production.

The preponderance of Bessemer steel in America is largely explained by the great and ever-expanding railway systems of the United States. The chief use for this steel is for making rails, and, as about 3,000 miles of new railway were laid during the year 1898 in the United States, it will be seen that there was a considerable tariff-protected home demand. Nevertheless the Americans reported over six and three-quarter million dollars' worth of rails (about 300,000 tons) in 1898. Our exports of rails for the same year amounted to a little more, 476,047 tons. Open hearth steel is more largely used for ship building and boiler construction, a fact sufficient to account for the slight balance on our side in this material. According to the journal of the Iron and Steel Institute, the tonnage of new shipping constructed in the United Kingdom in 1898 was 1,610,000 tons. In all other countries taken together the total was only 701,000 tons; or, apart from British colonies, 675,979 tons, much less than one-half the product of the United Kingdom alone. The production of pig iron Germany, including Luxembourg, was in 1898, 7,402,717 metric tons, or about 1,200,000 tons less than that of Great Britain for the same period.

It will be of interest to compare the latest figures available, which are here quoted, with those of an earlier period, and one is aided in doing so by some admirable diagrams presented to the Iron and Steel Institute by Sir David Dale, in his presidential address to that society. In the year 1865 we commenced with a make of 225,000 tons of steel, the United States producing 13,000 tons. Matters went on without very much change for about five years, but in 1870 the products of both countries took a sudden rise, which continued steadily until 1878, when Great Britain manufactured 1,117,000 tons and America 743,000 tons of steel. Then we had a check for a year, so that our figures were brought down almost to the American total; after which the two countries made a pretty close race until 1887, the Americans, however, passing us for the first time in 1885. About this period the production of steel increased with marvelous rapidity, so that in 1887 America was turning out 3 393 000 tons and we about 200,000 tons less. In the latter year, however, the American trade received a severe check, dropping nearly half a million tons by 1888, but we continued to soar upward, so that in the latter year we were something approaching a million tons ahead. Then our turn came for a check, while America recovered to such an extent that in 1890 she had a total of 4,346,000 tons, or about 700,000 tons beyond our output. After this began a period of depression for us, and we were soon followed by America on the downward course, so that in 1893 the totals were not very far apart.

Then commenced the most wonderful change in the history of the trade; the United States total soaring away—though there was a slight check in 1895—until in five years the figures were increased not very far from threefold, the total for 1898 being over 9,000,000 tons (9,075,783 tons) of steel. We in Great Britain have followed America in this later spurt of the industrial race, but at a respectful distance, our total for 1898 being 4,639,042 tons, according to Mr. R. R. Rothwell's "Mineral Industries," Vol. VII., p. 401. It is interesting to note that, while England and America have thus, for the last 30 years, been putting forth such strenuous efforts to keep up the supply of steel, sometimes leaping ahead, at other times falling back as if to gain energy for still greater exertions, Germany, their nearest rival, has been making continuous progress. Thus, in 1865 she was only second to ourselves on Sir David Dale's diagram, and she held her position until 1875, when America passed her and took the second place. After this Germany long remained third, but, climbing steadily upward with hardly a lapse, in 1896 she was almost tied with us. The next year she gained the second place by an excess over our total of nearly half a million tons, and in 1898 she had a total of 5,734,307 tons, which was double her output five years previously, and more than a million tons above our figure for the same year. France and Russia are the only other countries whose produce of steel in 1898 ran into seven figures, the former making nearly a million and a half tons and the latter just over a million. Belgium, which has been an active competitor with us in some sections of steel, even in our own market, produced only 653,130 tons in 1898, about 48,000 tons more than Austria-Hungary.

It will be seen, therefore, that while we were, ten years before the period last named, in the first place as a steel-producing country, both the United States and Germany have beaten us in this most important feature of manufacturing industry.

I will sum up this section of industrial record by again quoting Mr. Rothwell:—

"In 1898 the United States made 32·8 per cent.; Great Britain 24 per cent.; and Germany 20·3 per cent. of all the pig iron; these three countries furnishing 77·1 per cent. of the world's supplies. In steel the United States reports 37·6 per cent.; Germany 23·9 per cent.; and Great Britain, 19·3 per cent.; the three countries supplying 80·8 per cent. of the total output. Of these three leading countries Great Britain is nearly stationary at present, the increase coming in larger part from

the United States, but in a very considerable quantity from Germany."

Important as steel undoubtedly is in the manufacturing industry of a nation, it would naturally be foolish to jump at the conclusion that the country producing the greatest tonnage must be the most prosperous. We have shown that, though third in steel production, we are only second to the United States in our output of pig iron, while in another mineral—and that which has often been said to be the true pulse of industrial activity—we still stand first. During 1898 we raised, according to The Journal of the Iron and Steel Institute, 202,054,516 tons of coal in the United Kingdom. The United States were not very far behind, producing 197,864 936 tons during the same year; while Germany took third place with 90,279,992 tons of coal and 31,648,498 tons of lignite, the colorific value—the true measure of usefulness—of the latter being much lower than that of good coal. During 1898 about 36,500,000 tons of coal were exported from the United Kingdom, while the United States exported about 4,000,000 tons. Our total for 1899 will considerably exceed that of 1898. According to these figures there were roughly 28,000,000 tons more coal consumed in the United States than in England during the year.

Leaving the reader to interpret these figures according to his views, I turn to the exports and imports of the two countries under the heading of "Iron and Steel, and Manufactures thereof."

Here we meet with a difficulty which is the bane of all inquirers who have to make comparisons between the statistics of different countries. Under the above heading the American returns have 44 items, while our own government tables give us but 26. This would not be of great importance if the additional American items could be combined in a manner that would make them harmonize with the British classification, but unfortunately the whole arrangement is so involved that no sorting out of this kind is possible.

Taking the figures in the gross, however, we find that the United Kingdom exported during 1898, roughly 24½ million pounds' worth of iron and steel and manufactures thereof (including cutlery); while the total given for the United States by the American Bureau of Statistics is somewhat over 14½ million pounds—if we turn dollars into pounds allowing 4s. 2d. to the dollar, the rate adopted in our Board of Trade returns, although it is not so much as the English traveler gets for his money in the United States. The figures are a little uncertain, owing to a mystery respecting "Hardwares," which probably add somewhat to the American total, so that our excess may be even greater than it appears. Taking the figures as nearly as I can work them out, I find that our exports in iron and steel, etc., exceeded those of the United States by £10,000,000.

We now look at the other side of the account and consider the imports. If we exclude iron ore, we find about 8¾ million pounds' worth of iron and steel coming into the Kingdom during the year 1899. The United States, on the other hand, imported rather less than 2¾ million pounds' worth under the same heading. The United Kingdom, therefore, imported about six million pounds' worth more iron and steel than the United States in 1898. It may be added that we, who formerly thought ourselves so secure on our natural supplies, imported during the year 1898 about 40 times (in value) as much ore as American iron and steel makers did, in spite of our smaller make of iron and steel.

The facts are significant from more points of view than one. We in England speak of the United States as a protectionist country, and no doubt we do so with literal truth. Probably, if there had been no protective duties on iron and steel, the American imports might have been higher, and to some extent the American consumer may thus have been put in a worse position. This probability of outside supply, supposing duties to be relaxed, is becoming less and less every year, owing to the advances made by American steelmakers, enabling them to compete on equal terms with our older industries. But if, instead of using the term "protectionist country" literally, we may do violence to political geography and think of the States of the Union as separate countries—as economically they largely are—we have an area of highly civilized territory with free trade such as exists nowhere else in the world; for we must not forget that British colonies are very largely protective, even against the mother country. The wide expanse of territory in the great North American Republic, the variation in climate, and the profusion of mineral deposits—besides other natural riches—enable the different States of the Union to draw from each other duty free materials sufficient for the bulk of the country's industries. Doubtless some of these things could be bought to better advantage abroad; but, when all allowances have been made, the United States will be seen to stand on a different footing, as a protectionist nation, to any other country possessing an extensive manufacturing industry. Thus, much of the ore smelted in the great iron-making district of Pennsylvania comes from mines in other States, almost 1,000 miles away, but no duty is paid on it, and the Pittsburg trade is thus unhampered.—London Times.

Australian Butter Packing.—Attention has been attracted in Germany to a new method of packing butter, which has been tried with very satisfactory results in connection with shipments from Melbourne to Kimberley. This method, which, it is said, has already been extensively adopted in Australia, consists in placing the butter in a box formed of six plates of ordinary window glass, whose edges are closed with gummed paper; the glass box is covered with a layer of burnt gypsum (plaster of paris) 6 to 7 millimeters (about one-fifth of an inch) thick, and is then wrapped in specially prepared waterproof packing paper. As gypsum is a bad conductor of heat, a regular temperature is maintained within the glass box. At present, the cases are made of sufficient size to contain 100 kilogrammes (220 pounds) of butter.

This idea may prove of special value to firms in the United States engaged in shipping butter and other articles to tropical countries, especially if the question as to the proper size and construction of the boxes be given additional consideration. It seems likely, moreover, that this system of protecting delicate articles may be found useful even in the home market.—Geo. H. Murphy, Vice Consul at Magdeburg.

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